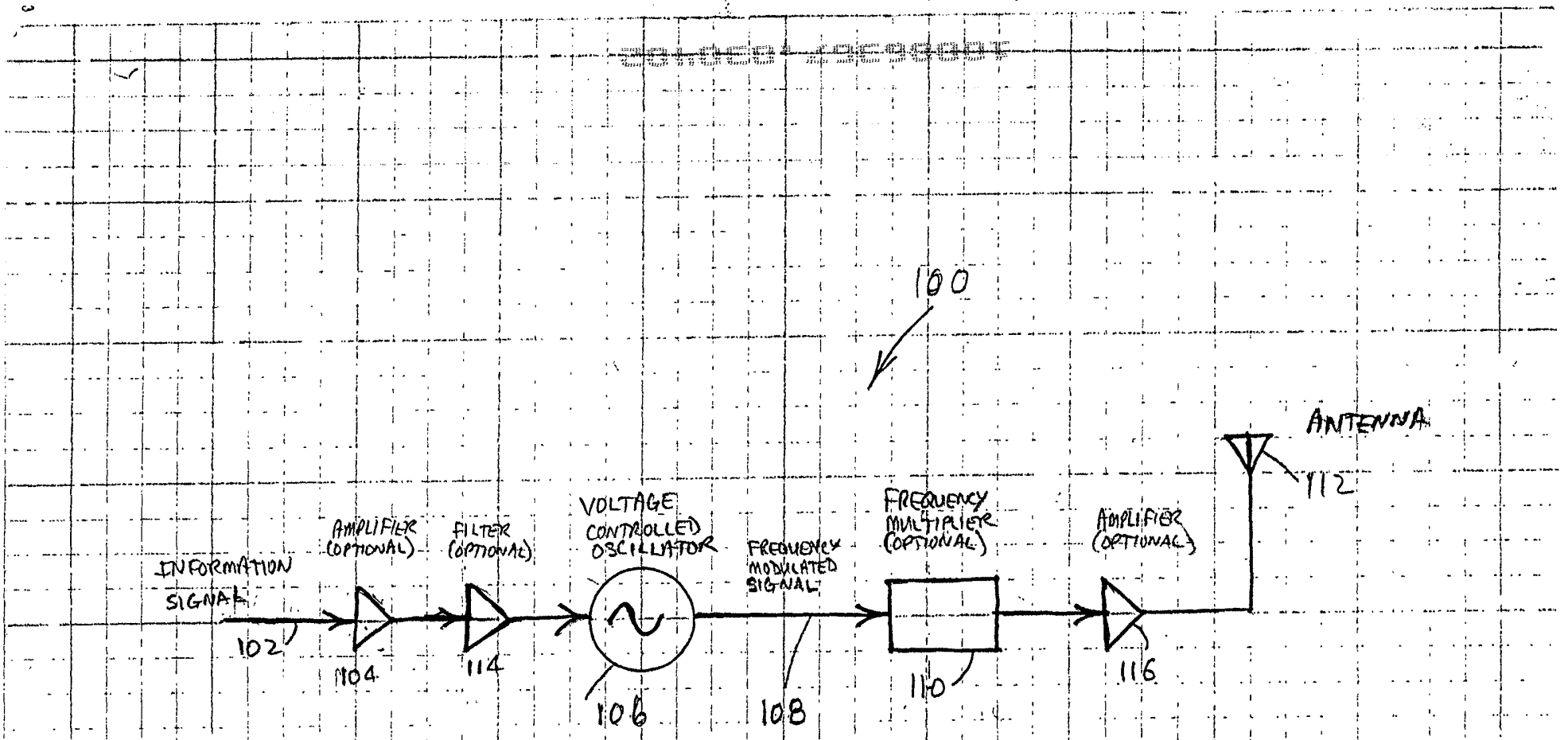


FREQUENCY MODULATION CIRCUIT

FIG. 1
(RELATED ART)

INFORMATION SIGNAL 102

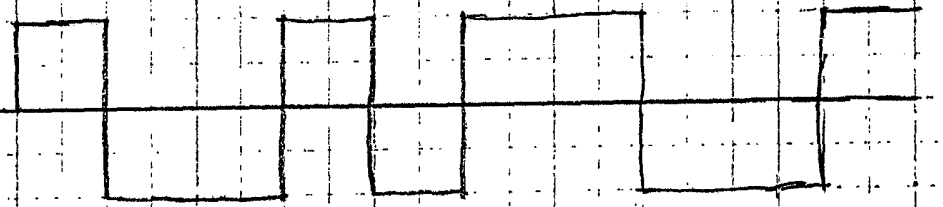


FIG. 2A

OSCILLATOR SIGNAL 202

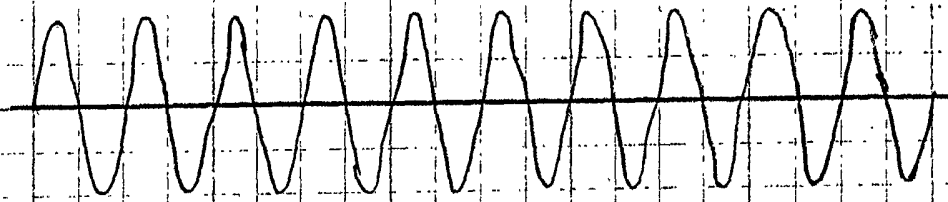


FIG. 2B

MODULATED SIGNAL 108

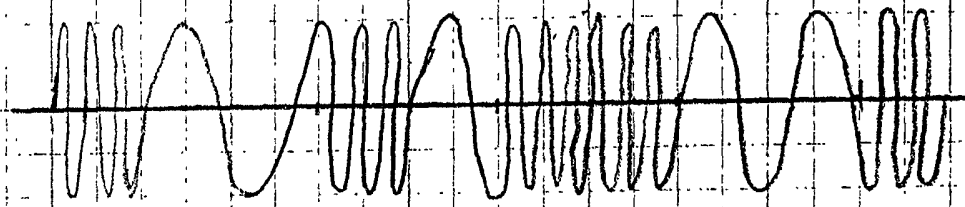
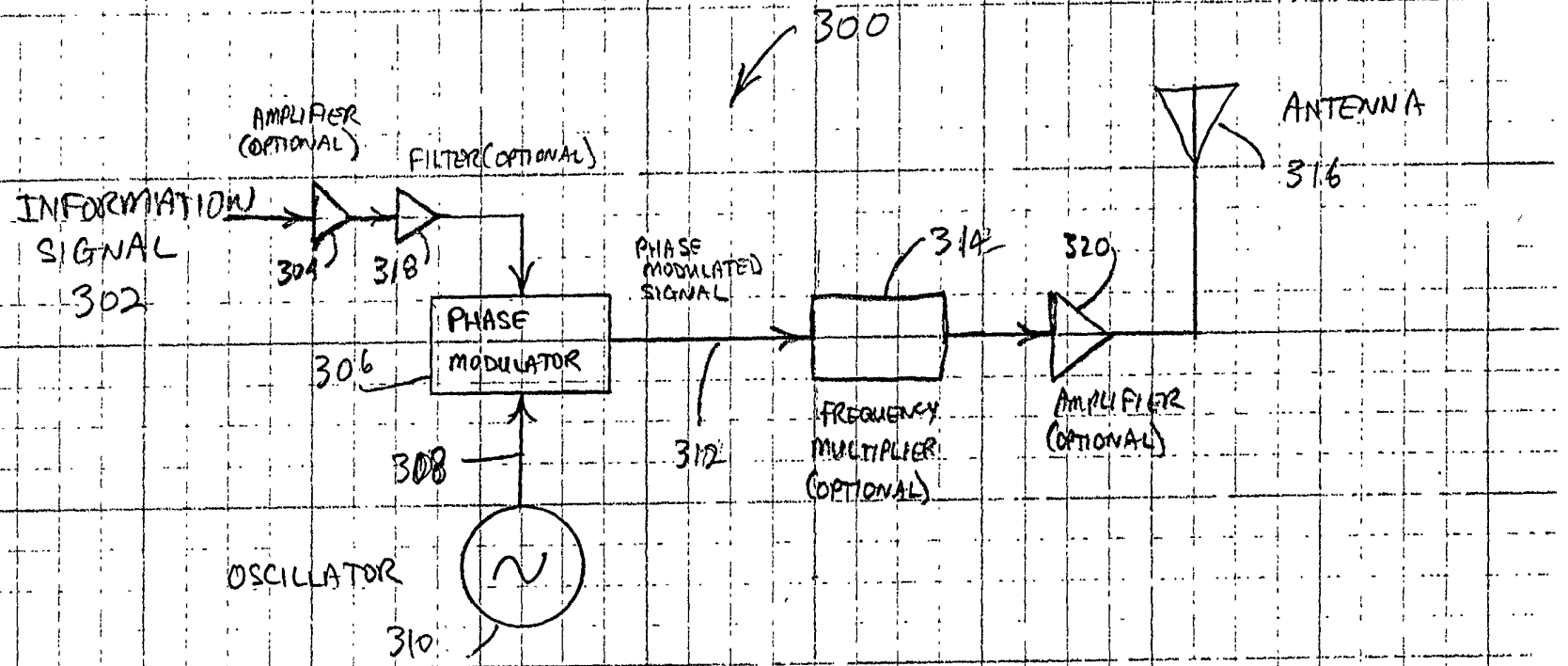


FIG. 2C

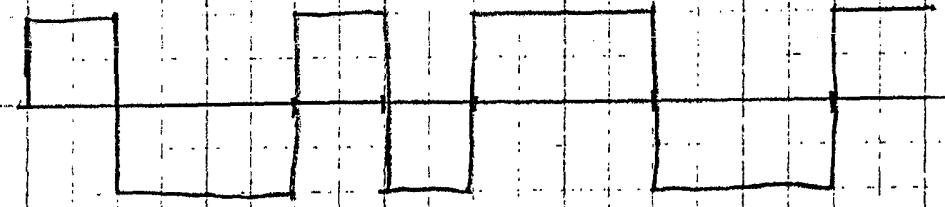
FREQUENCY MODULATION WAVEFORMS

FIG. 2
(RELATED ART)



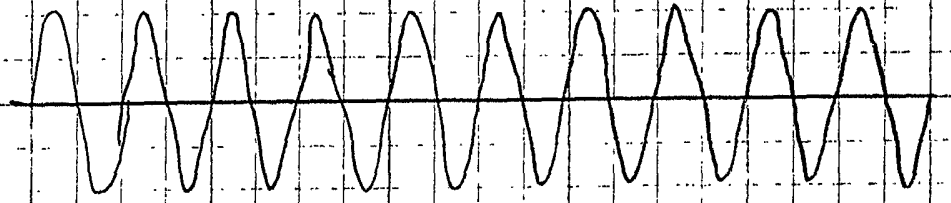
PHASE MODULATION CIRCUIT

FIG. 3
(RELATED ART)



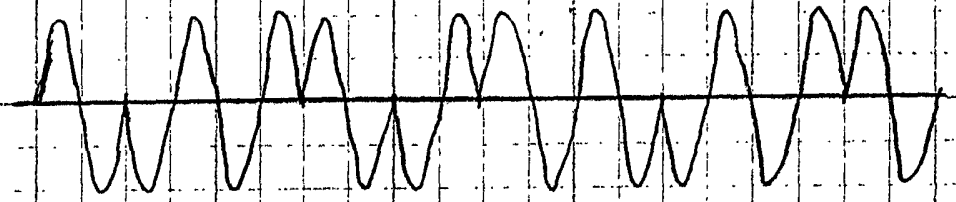
INFORMATION SIGNAL 302

FIG. 4A



OSCILLATOR SIGNAL 308

FIG. 4B

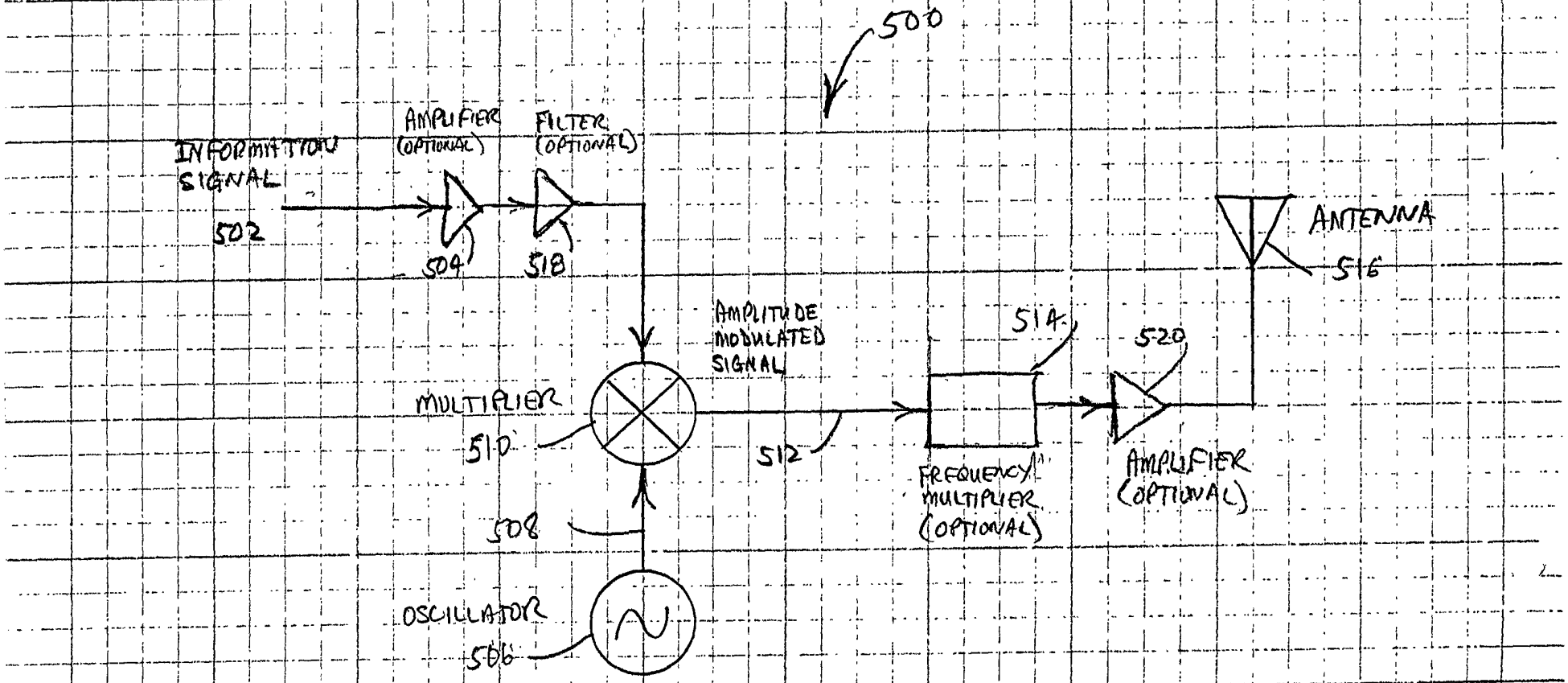


PHASE MODULATED SIGNAL 312

FIG. 4C

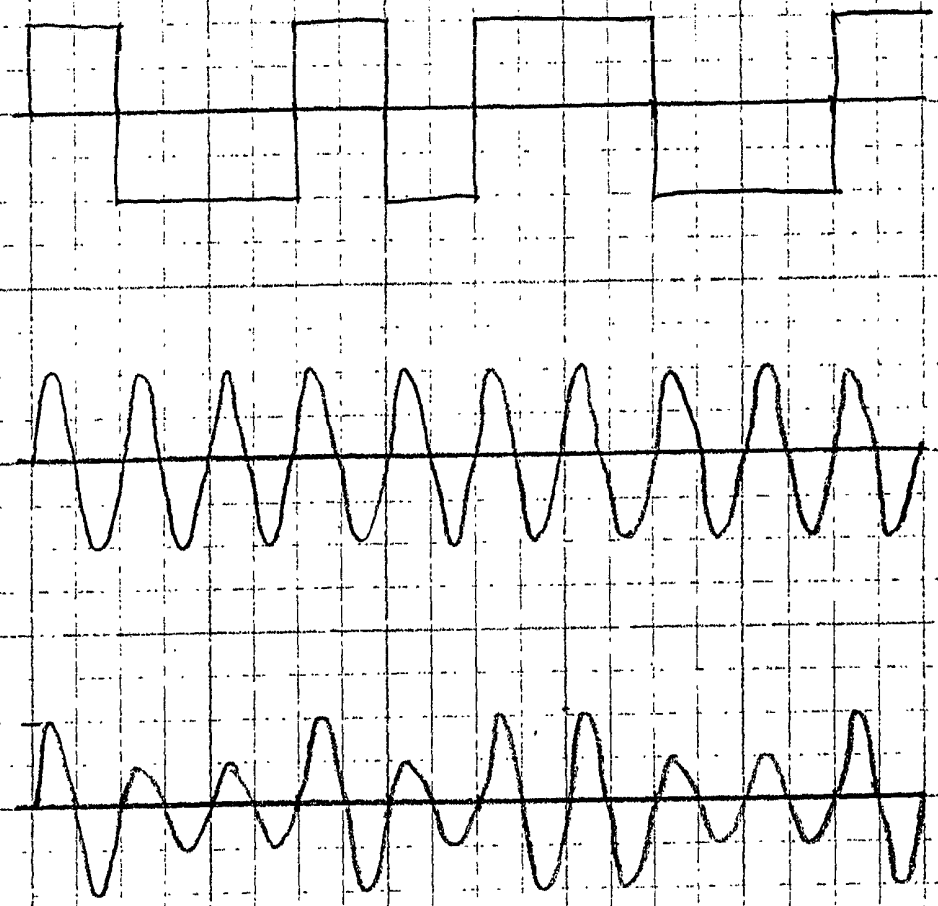
PHASE MODULATION WAVEFORMS

FIG. 4
(RELATED ART)



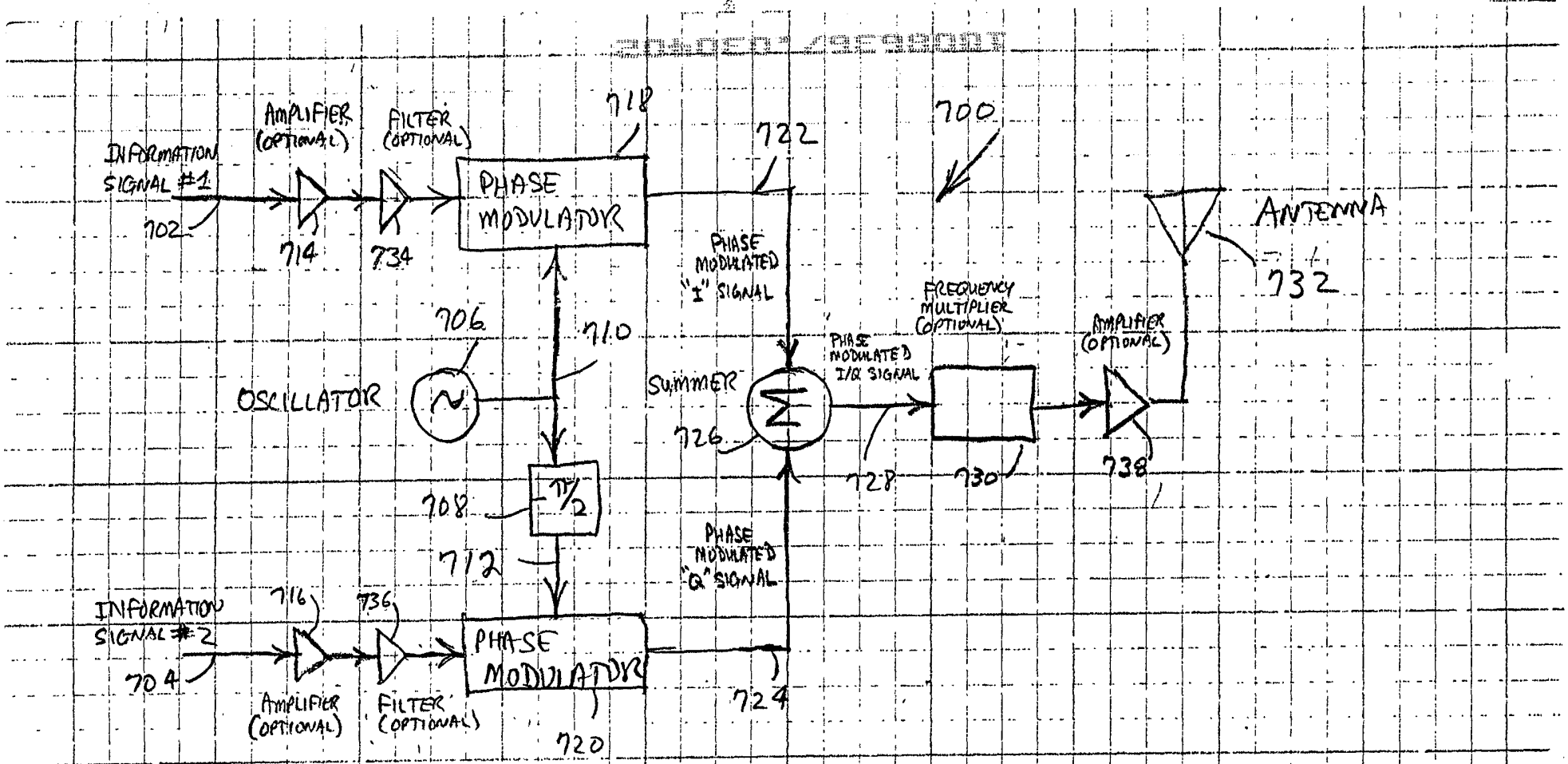
AMPLITUDE MODULATION CIRCUIT

FIG. 5
(RELATED ART)



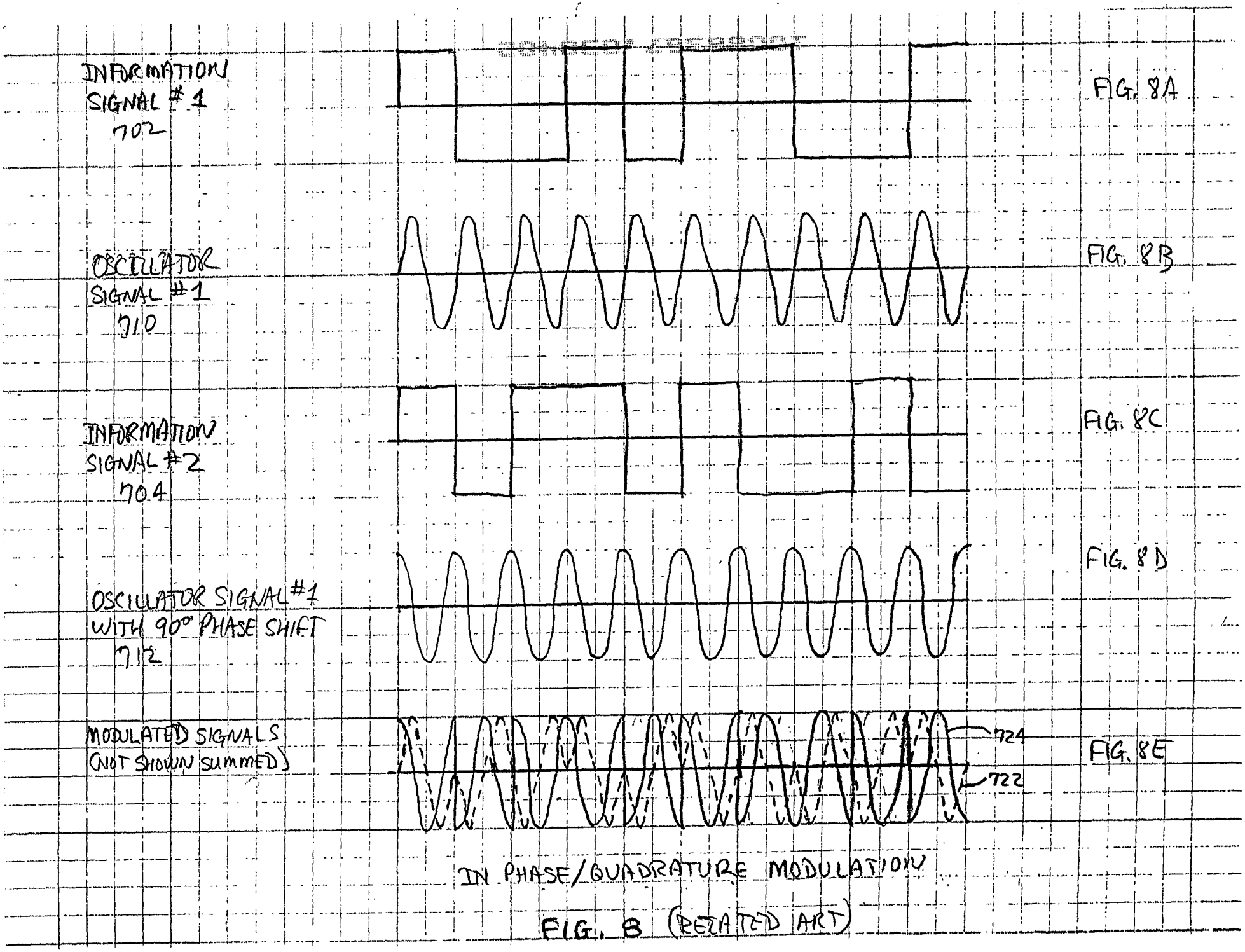
AMPLITUDE MODULATION

FIG. 6
(RELATED ART)



IN PHASE/QUADRATURE PHASE MODULATION CIRCUIT

FIG. 7
(RELATED ART)



IN PHASE/QUADRATURE MODULATION

FIG. 8 (RELATED ART)

Transmitter

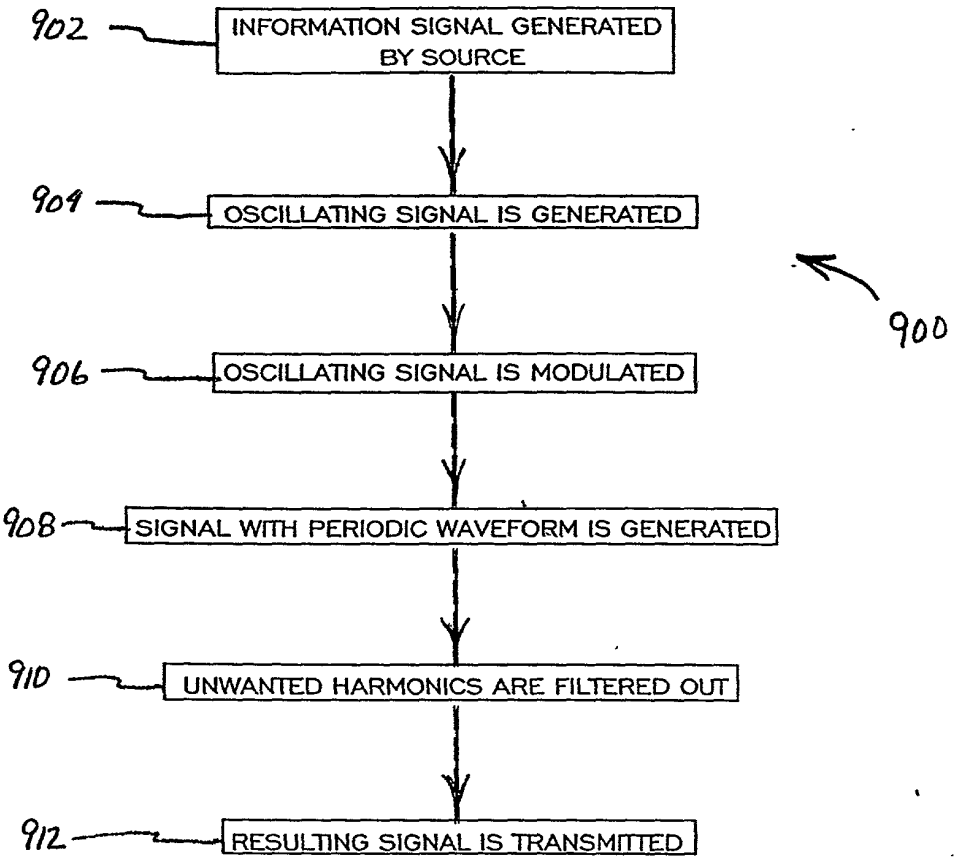
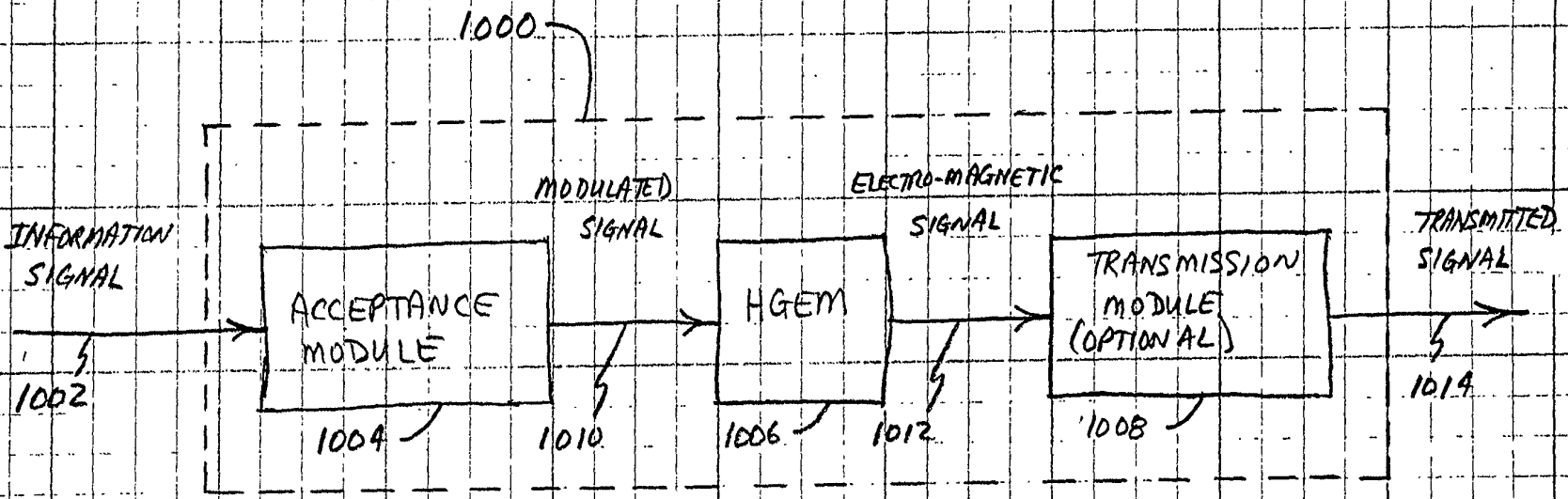


FIG. 9



TRANSMITTER EMBODIMENT

FIG. 10

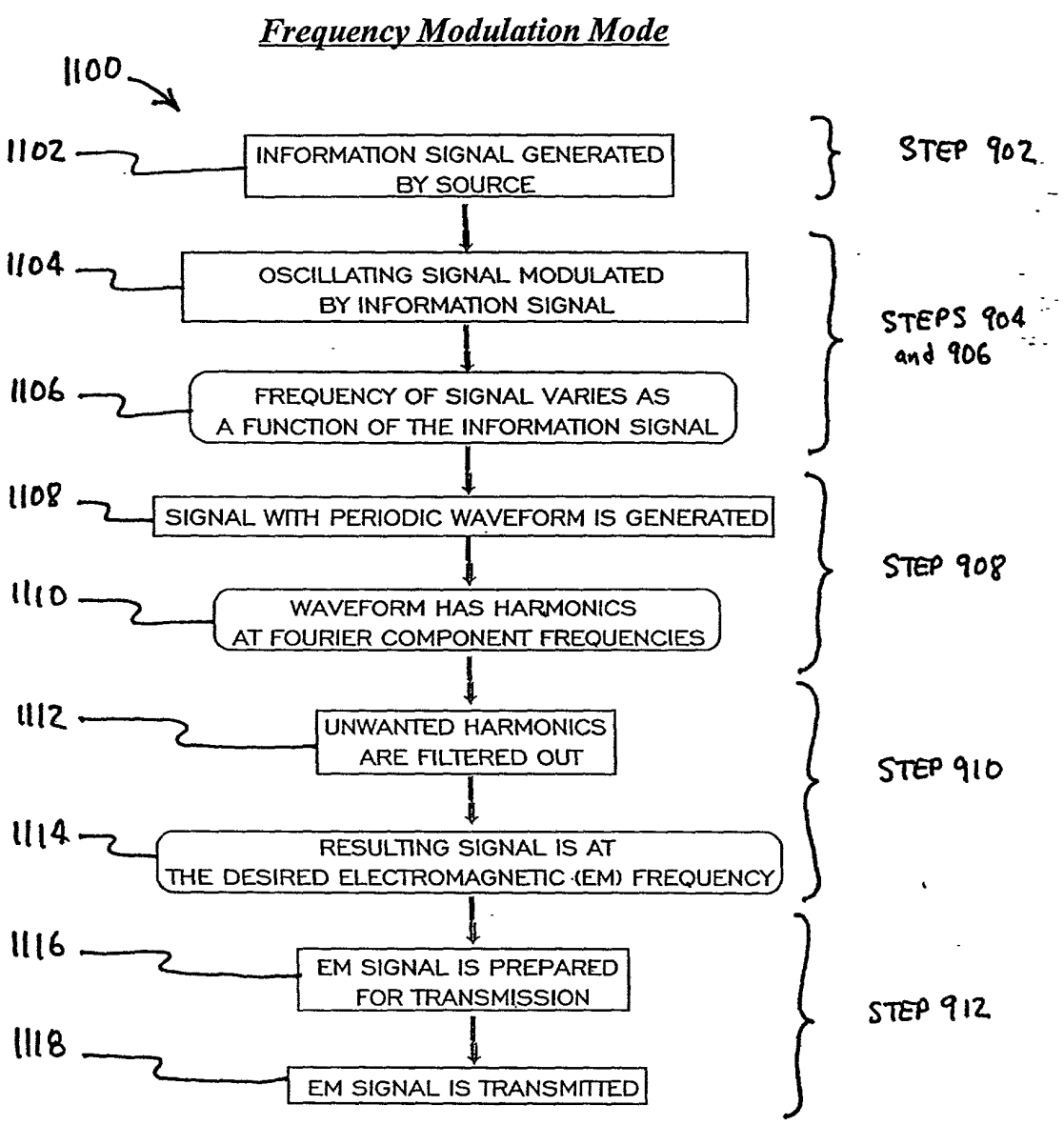

Frequency Modulation Mode
1100
1102
INFORMATION SIGNAL GENERATED BY SOURCE
STEP 902
1104
OSCILLATING SIGNAL MODULATED BY INFORMATION SIGNAL
1106
FREQUENCY OF SIGNAL VARIES AS A FUNCTION OF THE INFORMATION SIGNAL
STEPS 904 and 906
1108
SIGNAL WITH PERIODIC WAVEFORM IS GENERATED
1110
WAVEFORM HAS HARMONICS AT FOURIER COMPONENT FREQUENCIES
STEP 908
1112
UNWANTED HARMONICS ARE FILTERED OUT
1114
RESULTING SIGNAL IS AT THE DESIRED ELECTROMAGNETIC (EM) FREQUENCY
STEP 910
1116
EM SIGNAL IS PREPARED FOR TRANSMISSION
1118
EM SIGNAL IS TRANSMITTED
STEP 912

FIG. 11

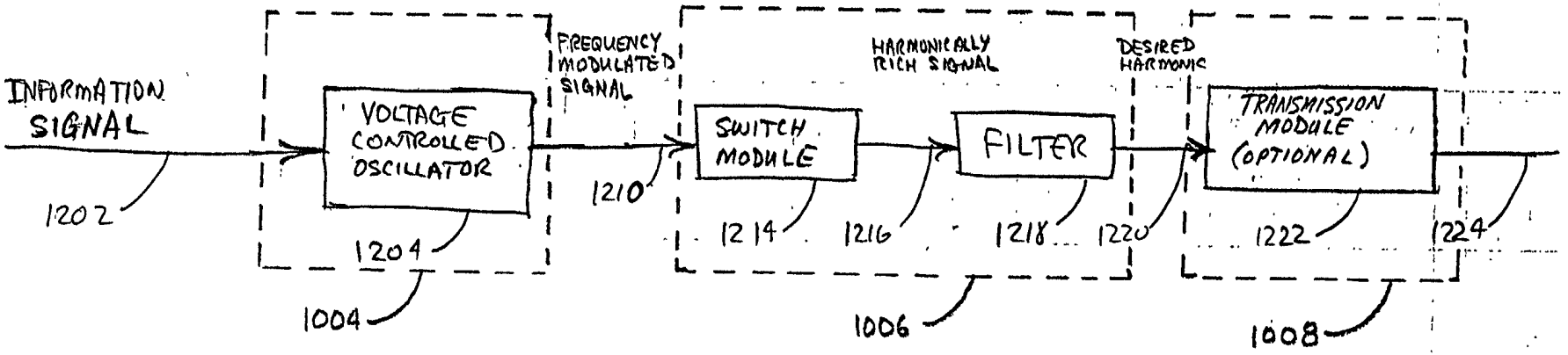


FIG. 12

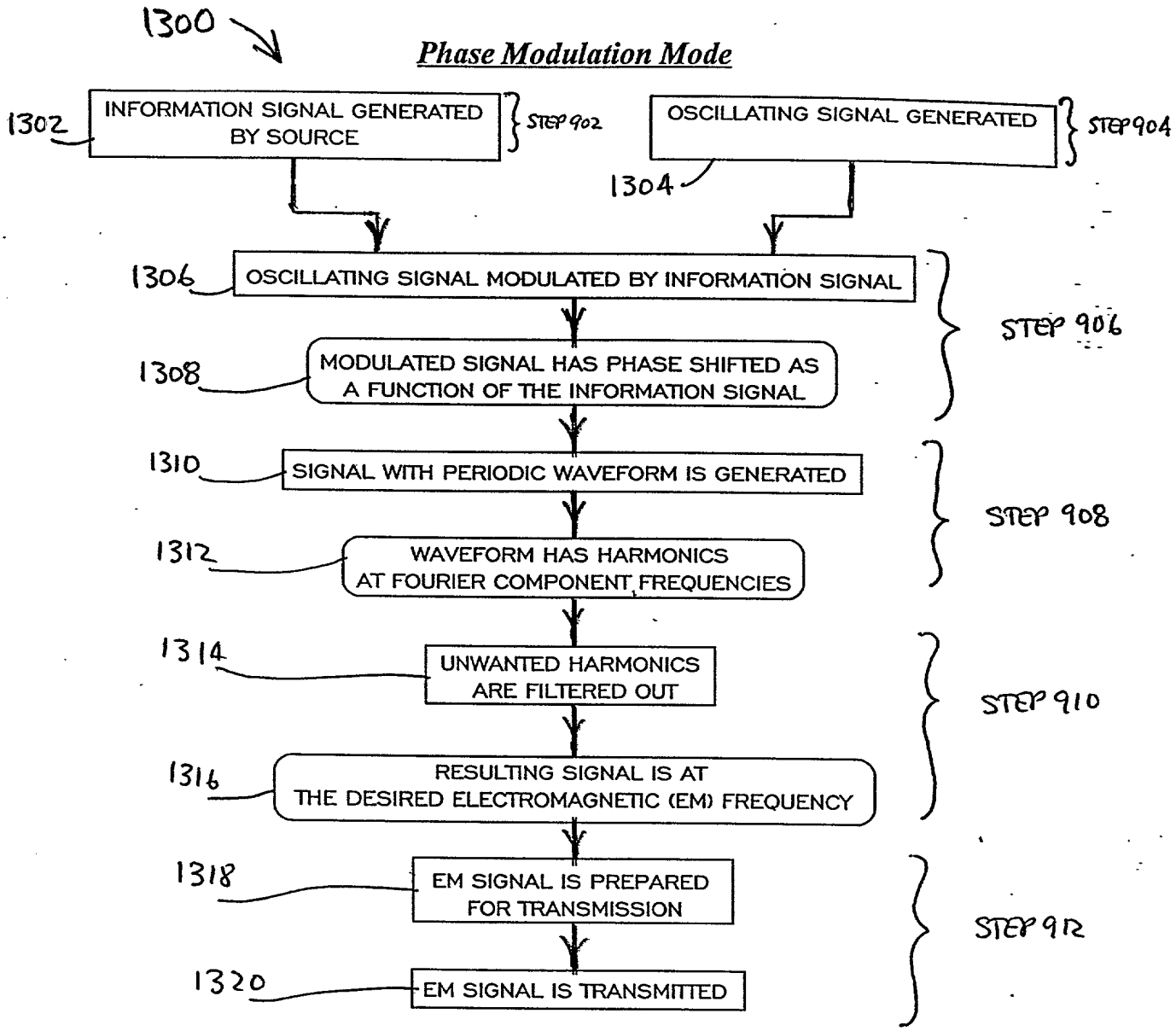

1300
Phase Modulation Mode
1302
INFORMATION SIGNAL GENERATED BY SOURCE
STEP 902
OSCILLATING SIGNAL GENERATED
STEP 904
1304
1306
OSCILLATING SIGNAL MODULATED BY INFORMATION SIGNAL
STEP 906
1308
MODULATED SIGNAL HAS PHASE SHIFTED AS A FUNCTION OF THE INFORMATION SIGNAL
1310
SIGNAL WITH PERIODIC WAVEFORM IS GENERATED
STEP 908
1312
WAVEFORM HAS HARMONICS AT FOURIER COMPONENT FREQUENCIES
1314
UNWANTED HARMONICS ARE FILTERED OUT
STEP 910
1316
RESULTING SIGNAL IS AT THE DESIRED ELECTROMAGNETIC (EM) FREQUENCY
1318
EM SIGNAL IS PREPARED FOR TRANSMISSION
STEP 912
1320
EM SIGNAL IS TRANSMITTED

FIG. 13

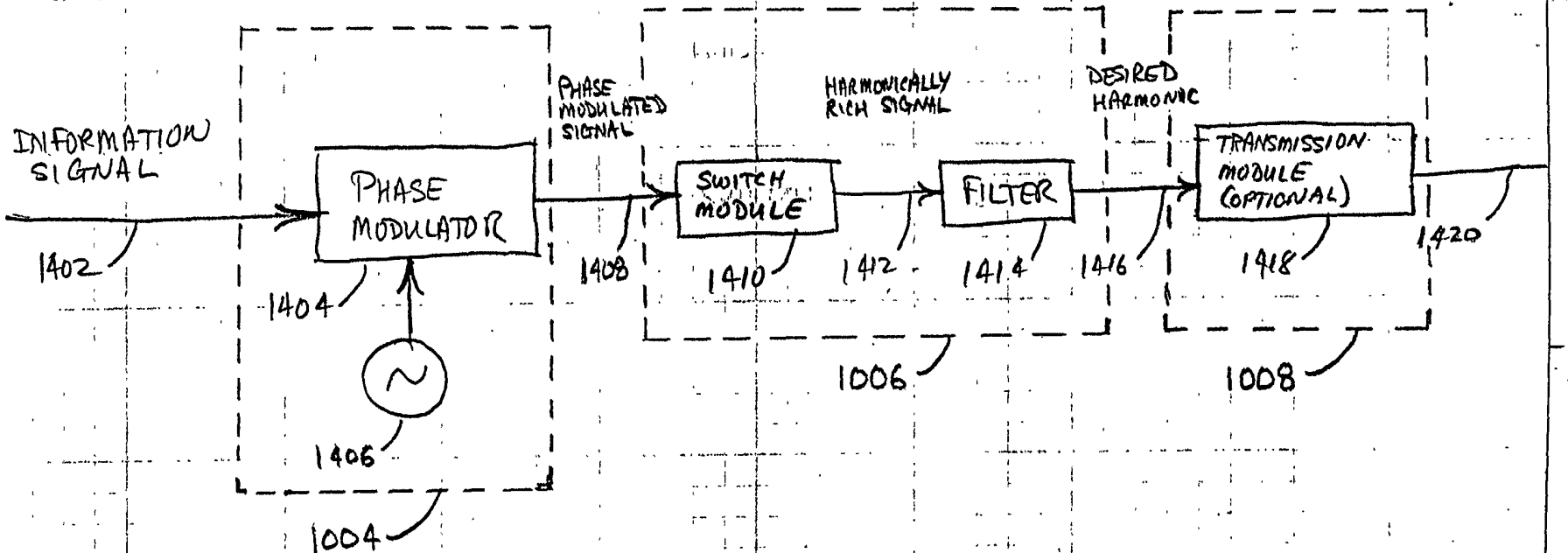


FIG. 14

Amplitude Modulation Mode

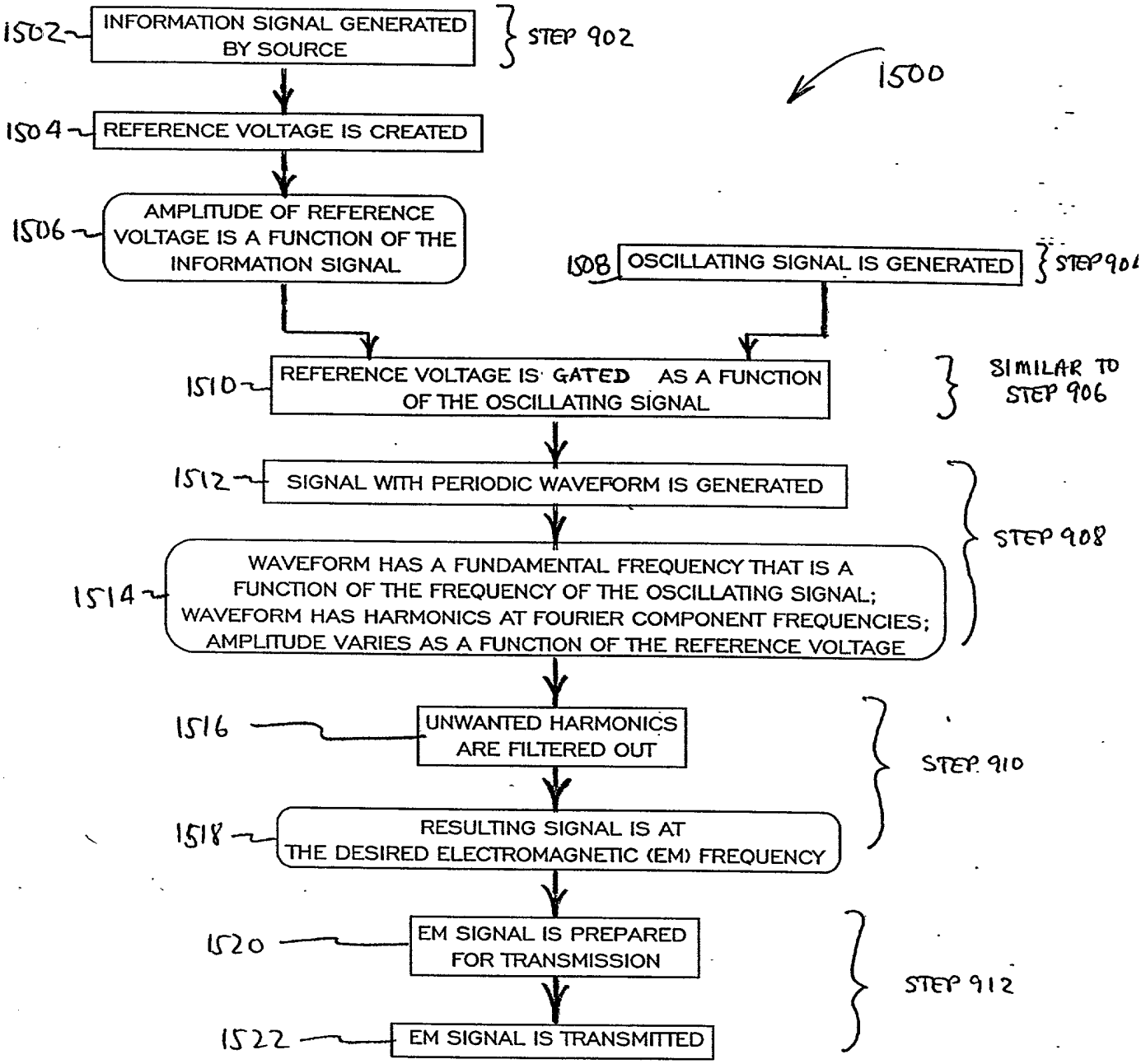


FIG. 15

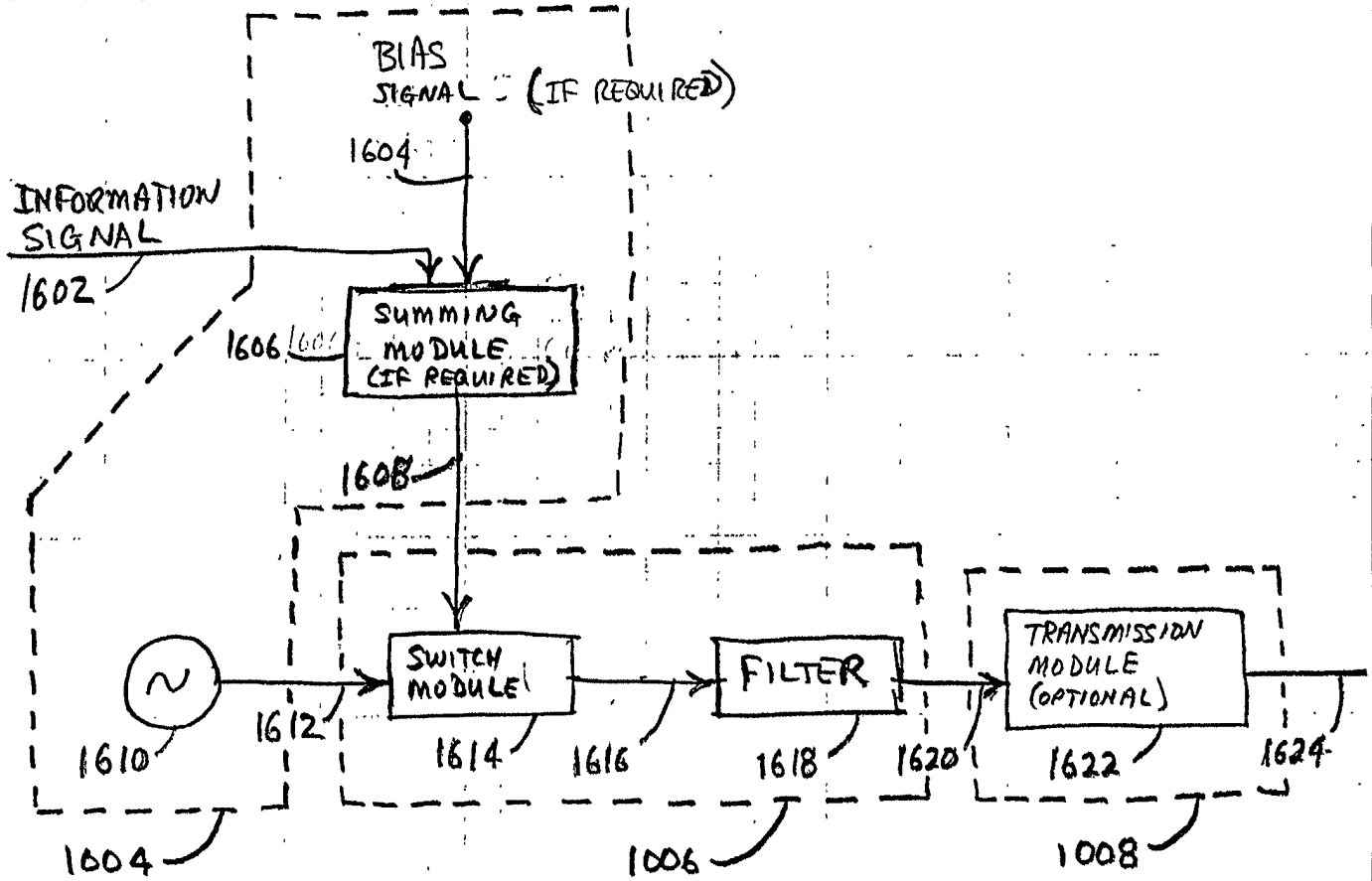


FIG. 16

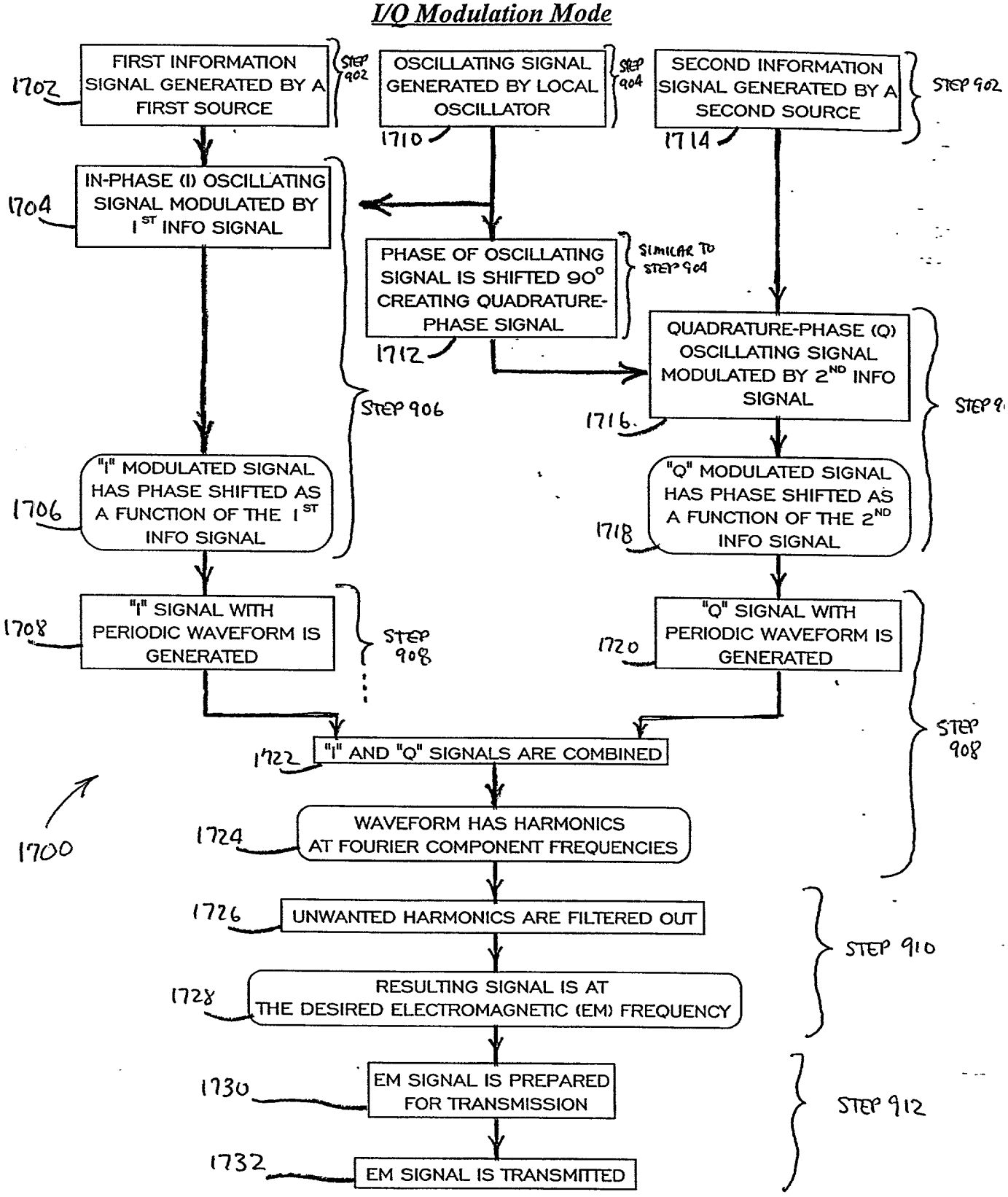

I/Q Modulation Mode
FIRST INFORMATION SIGNAL GENERATED BY A FIRST SOURCE
1702
STEP 902
OSCILLATING SIGNAL GENERATED BY LOCAL OSCILLATOR
1710
STEP 904
SECOND INFORMATION SIGNAL GENERATED BY A SECOND SOURCE
1714
STEP 902
IN-PHASE (I) OSCILLATING SIGNAL MODULATED BY 1ST INFO SIGNAL
1704
PHASE OF OSCILLATING SIGNAL IS SHIFTED 90° CREATING QUADRATURE-PHASE SIGNAL
1712
SIMILAR TO STEP 904
QUADRATURE-PHASE (Q) OSCILLATING SIGNAL MODULATED BY 2ND INFO SIGNAL
1716
STEP 906
"I" MODULATED SIGNAL HAS PHASE SHIFTED AS A FUNCTION OF THE 1ST INFO SIGNAL
1706
"Q" MODULATED SIGNAL HAS PHASE SHIFTED AS A FUNCTION OF THE 2ND INFO SIGNAL
1718
"I" SIGNAL WITH PERIODIC WAVEFORM IS GENERATED
1708
STEP 908
"Q" SIGNAL WITH PERIODIC WAVEFORM IS GENERATED
1720
"I" AND "Q" SIGNALS ARE COMBINED
1722
STEP 908
1700
WAVEFORM HAS HARMONICS AT FOURIER COMPONENT FREQUENCIES
1724
UNWANTED HARMONICS ARE FILTERED OUT
1726
STEP 910
RESULTING SIGNAL IS AT THE DESIRED ELECTROMAGNETIC (EM) FREQUENCY
1728
EM SIGNAL IS PREPARED FOR TRANSMISSION
1730
STEP 912
EM SIGNAL IS TRANSMITTED
1732

FIG 17

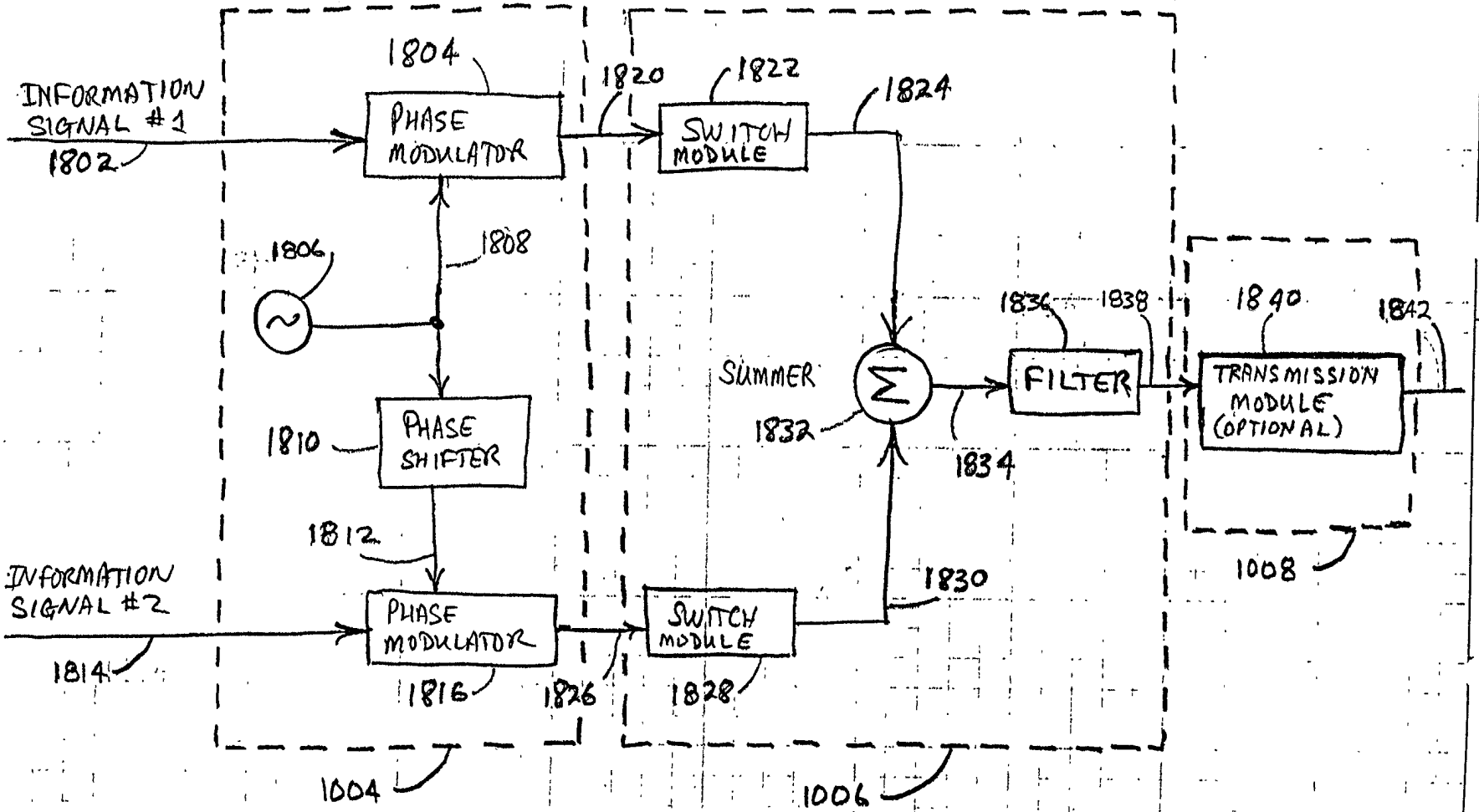
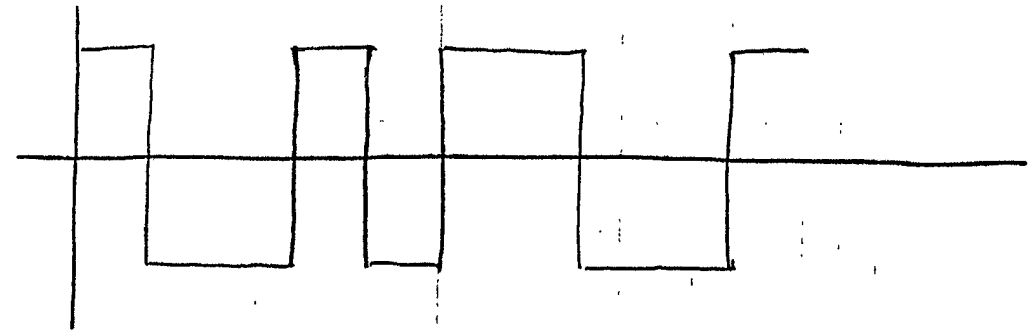
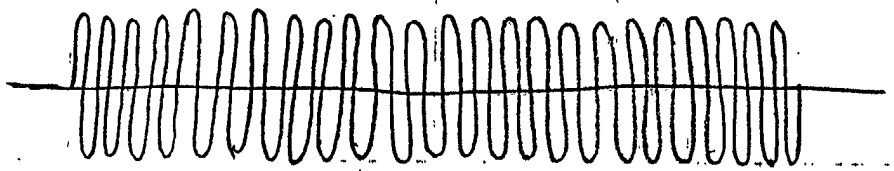


FIG. 18



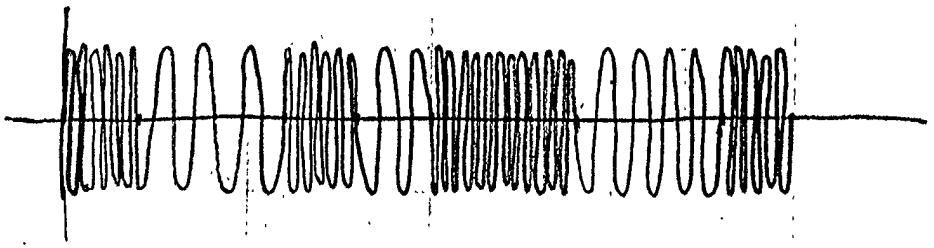
INFORMATION SIGNAL 1902

FIG. 19A



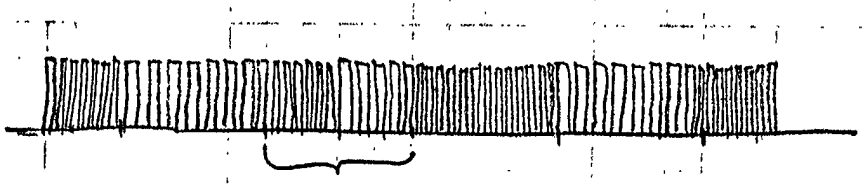
OSCILLATING SIGNAL 1904

FIG. 19B



MODULATED SIGNAL (SHOWN AS FM) 1906

FIG. 19C



SIGNAL WITH RECTANGULAR WAVEFORM (SHOWN AS SQUARE WAVE) 1908

SEE FIG. 19E 1910

FIG. 19D

FIG. 19

PERIODIC WAVEFORM
(SHOWN EXPANDED)
(SHOWN AS SQUARE WAVE)
1910

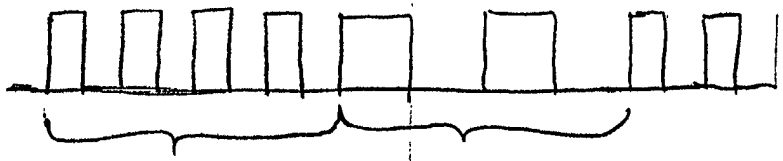
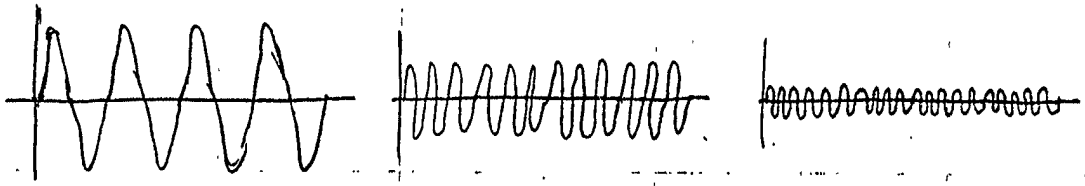


FIG. 19E

SIGNAL A
SEE FIGS. 19F
1912

SIGNAL B
SEE FIGS. 19G
1914

HARMONICS OF SIGNAL A
(SHOWN SEPARATELY - ALL OCCUR SIMULTANEOUSLY)
(SHOWN EXPANDED)
1912



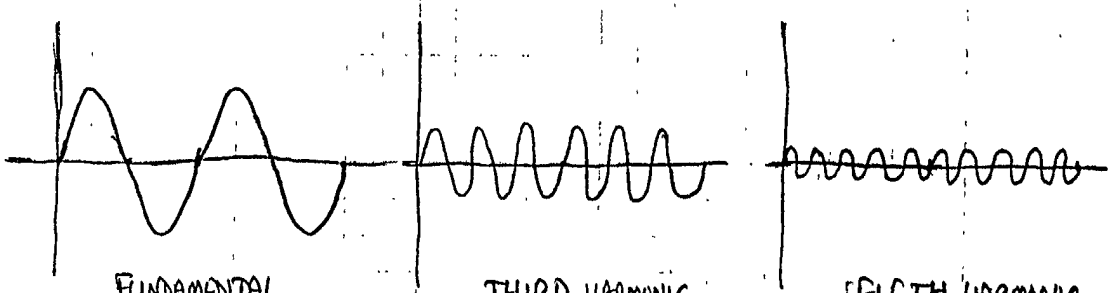
FIGS. 19F

FUNDAMENTAL FREQUENCY (f_f)
1912a

THIRD HARMONIC
(3 TIMES f_f)
1912b

FIFTH HARMONIC
(5 TIMES f_f)
1912c

HARMONICS OF SIGNAL B
(SHOWN SEPARATELY - ALL OCCUR SIMULTANEOUSLY)
(SHOWN EXPANDED)
1914



FIGS. 19G

FUNDAMENTAL FREQUENCY (f_f)
1914a

THIRD HARMONIC
(3 TIMES f_f)
1914b

FIFTH HARMONIC
(5 TIMES f_f)
1914c

FIG. 19 (cont)

HARMONICS OF SIGNAL A & B (SHOWN SIMULTANEOUSLY BUT NOT SUMMED) (SHOWN EXPANDED) 1916

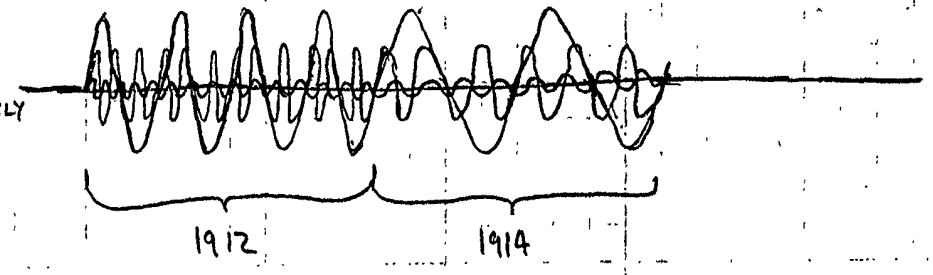


FIG. 19H

FILTERED SIGNAL A & B (SHOWN EXPANDED) 1918

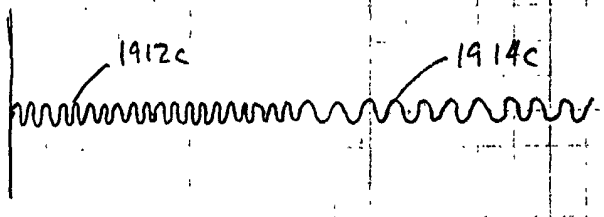
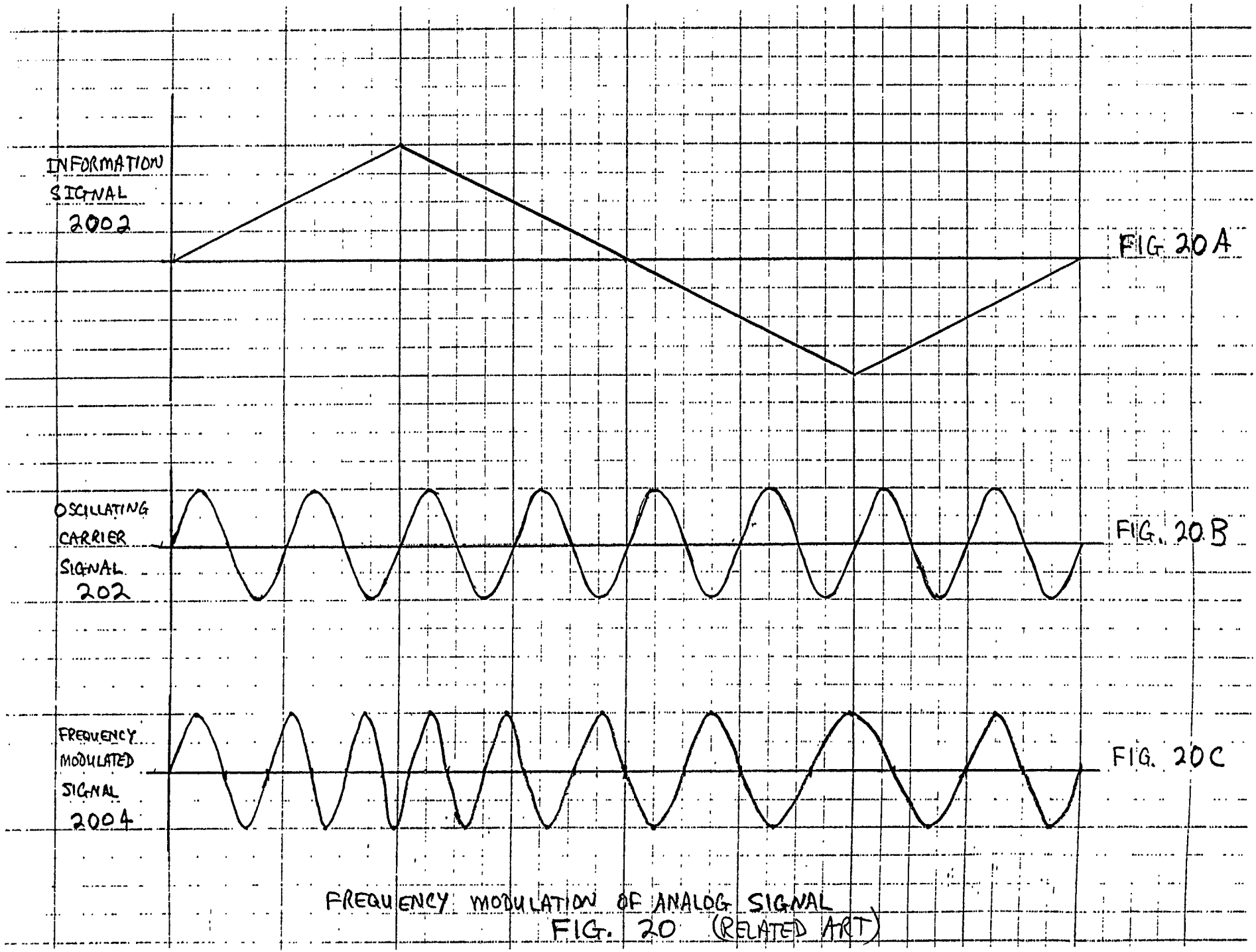
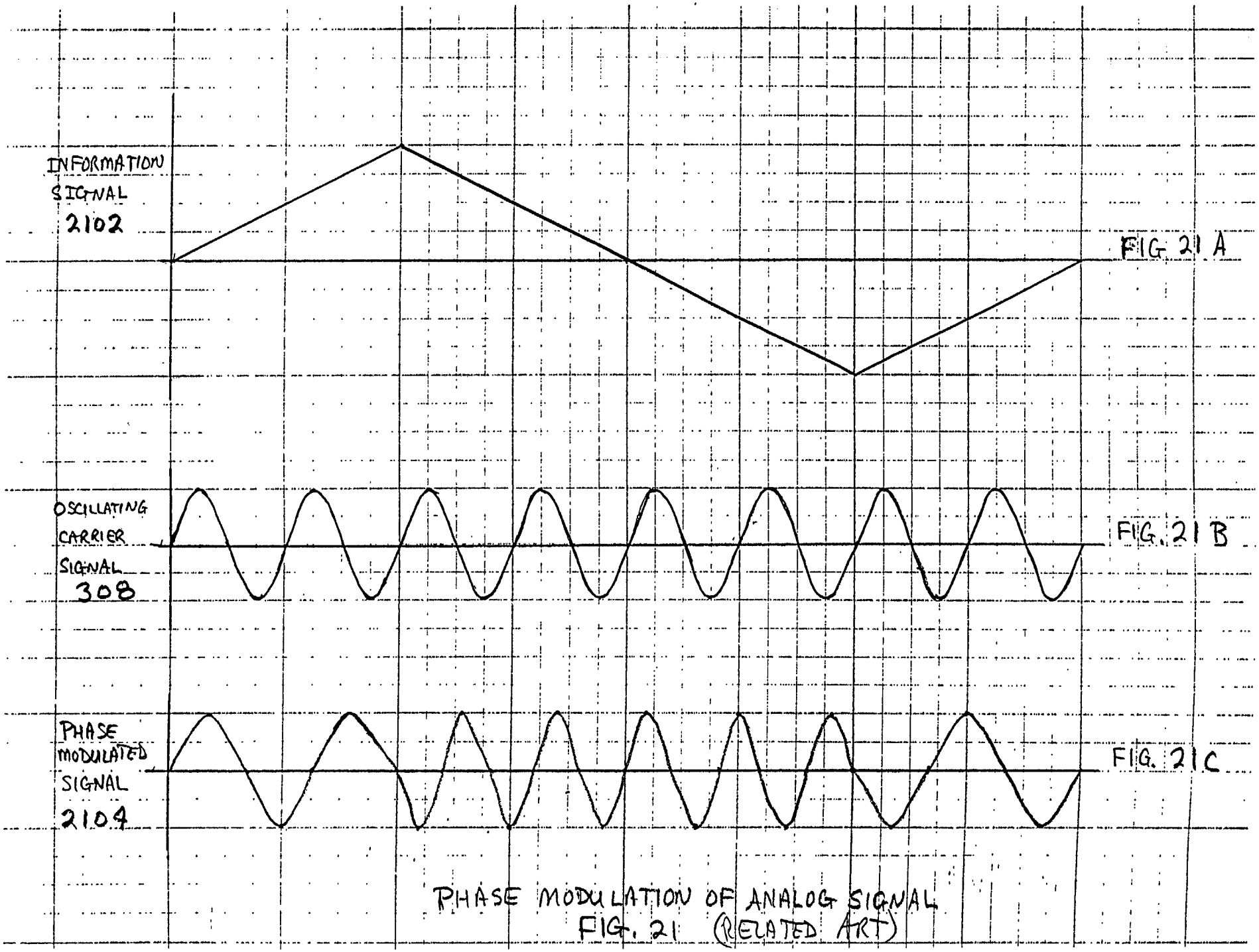


FIG. 19I

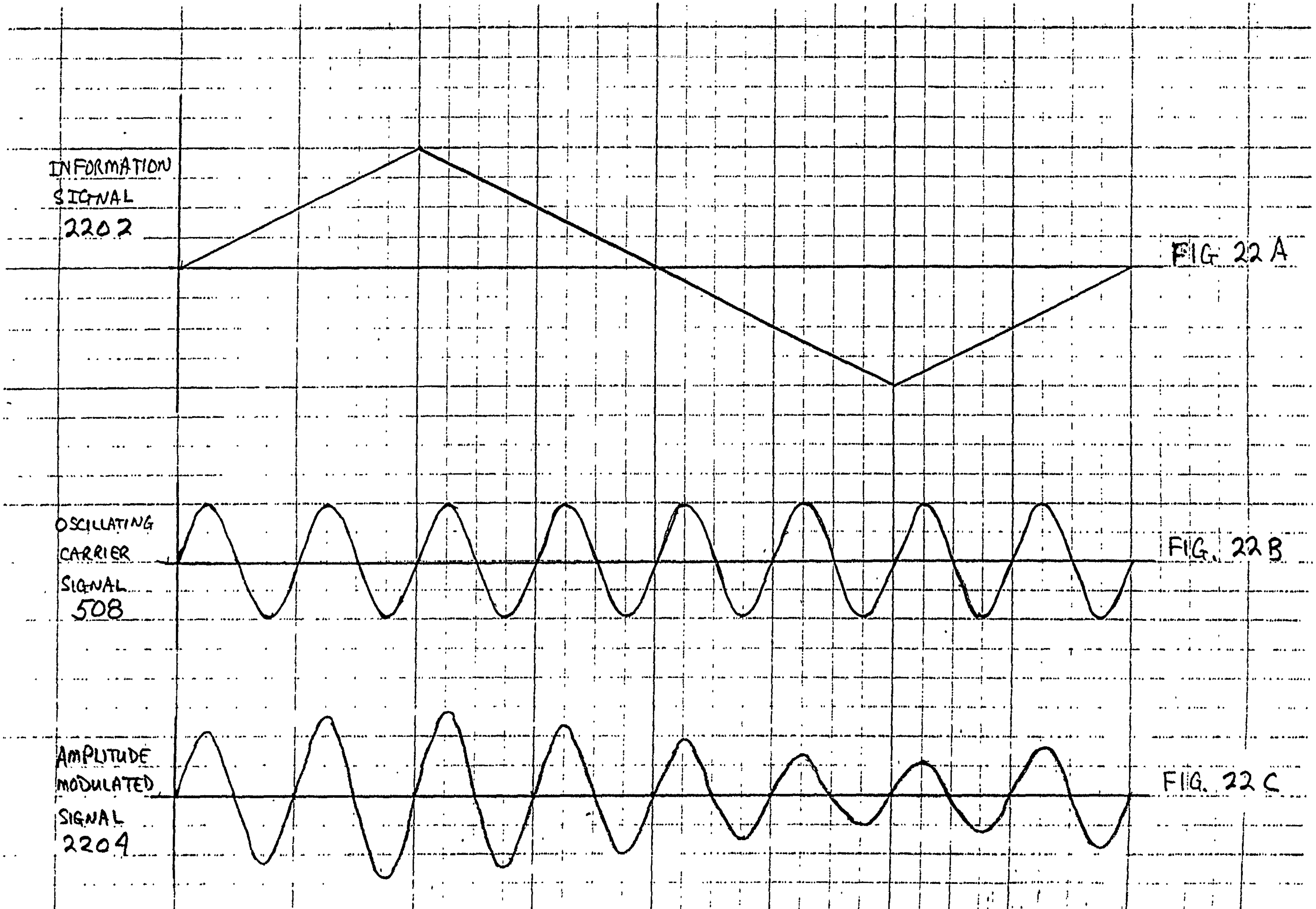
FIG. 19 (cont)



FREQUENCY MODULATION OF ANALOG SIGNAL
FIG. 20 (RELATED ART)



PHASE MODULATION OF ANALOG SIGNAL
FIG. 21 (RELATED ART)



AMPLITUDE MODULATION OF ANALOG SIGNAL
FIG. 22 (RELATED ART)

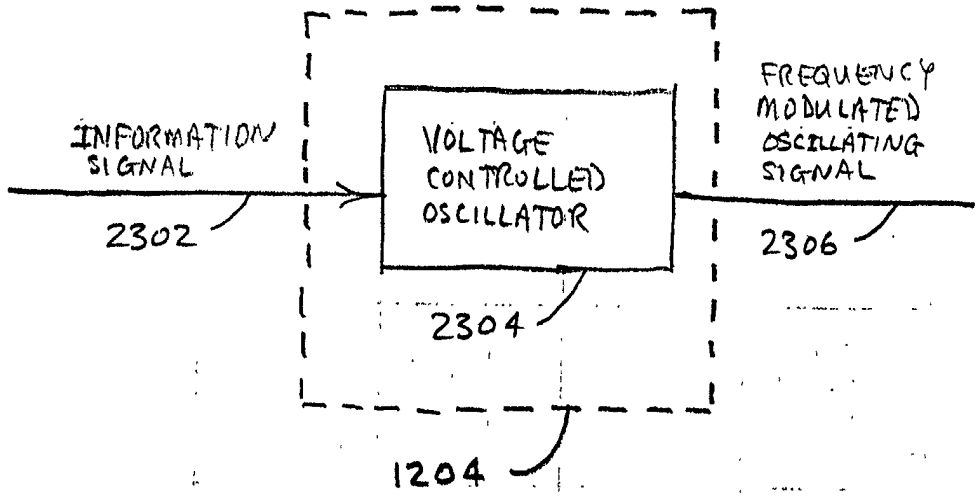


FIG. 23

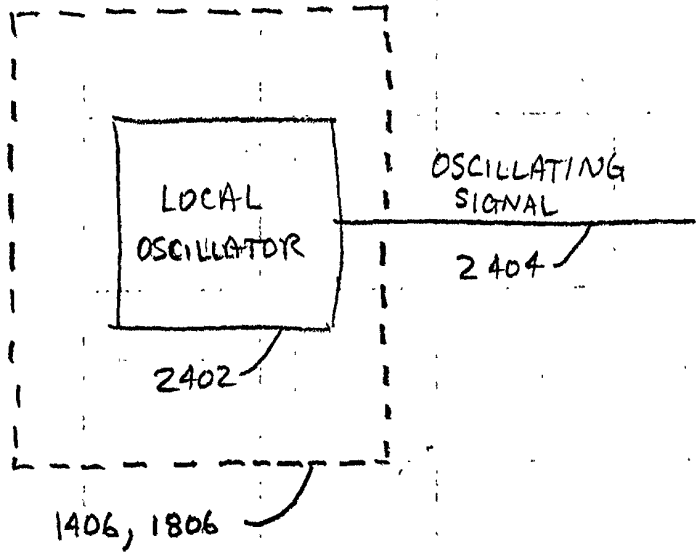


FIG. 24

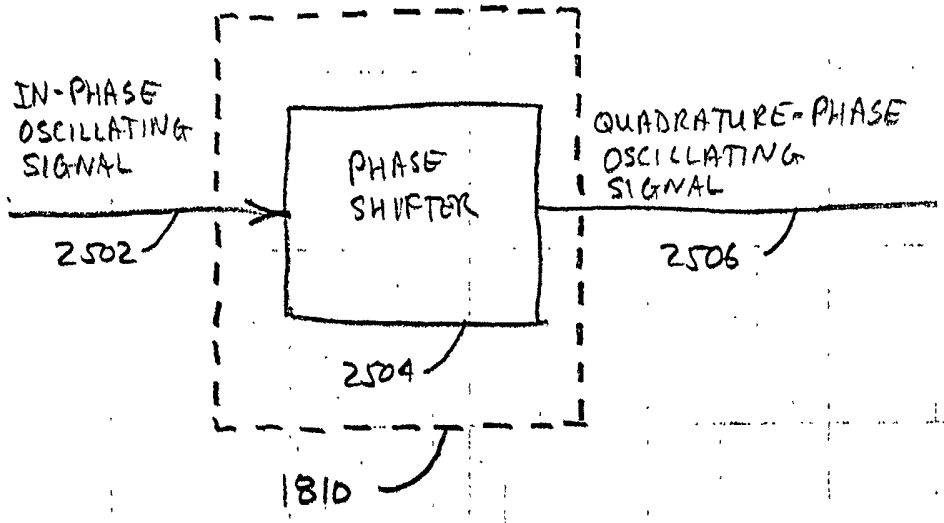


FIG. 25

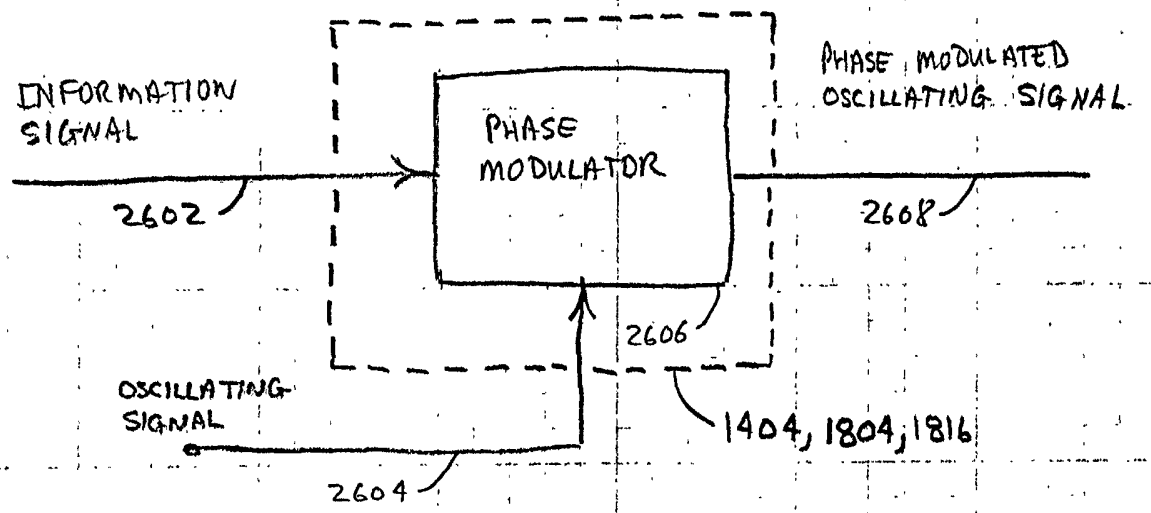


FIG. 26

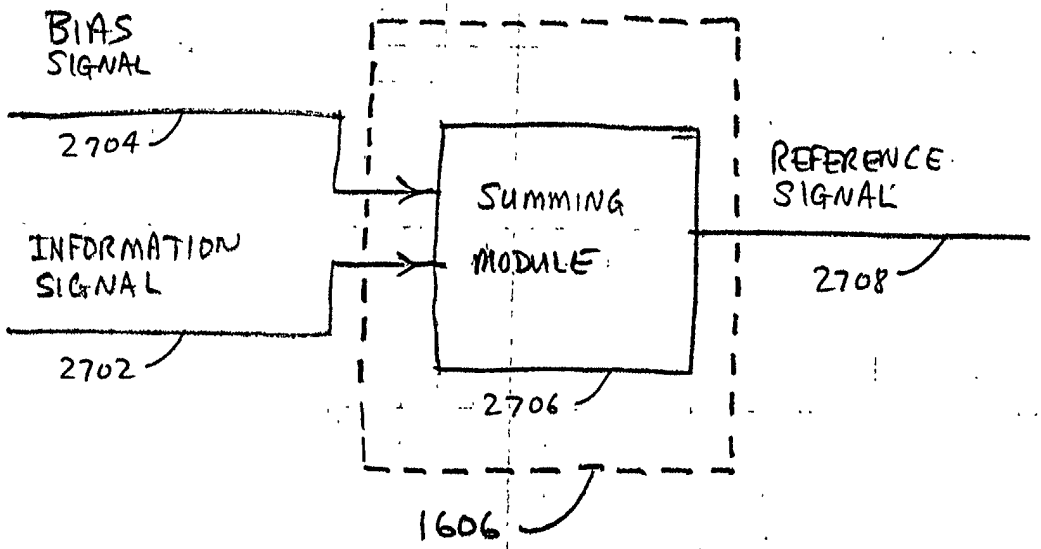


FIG. 27

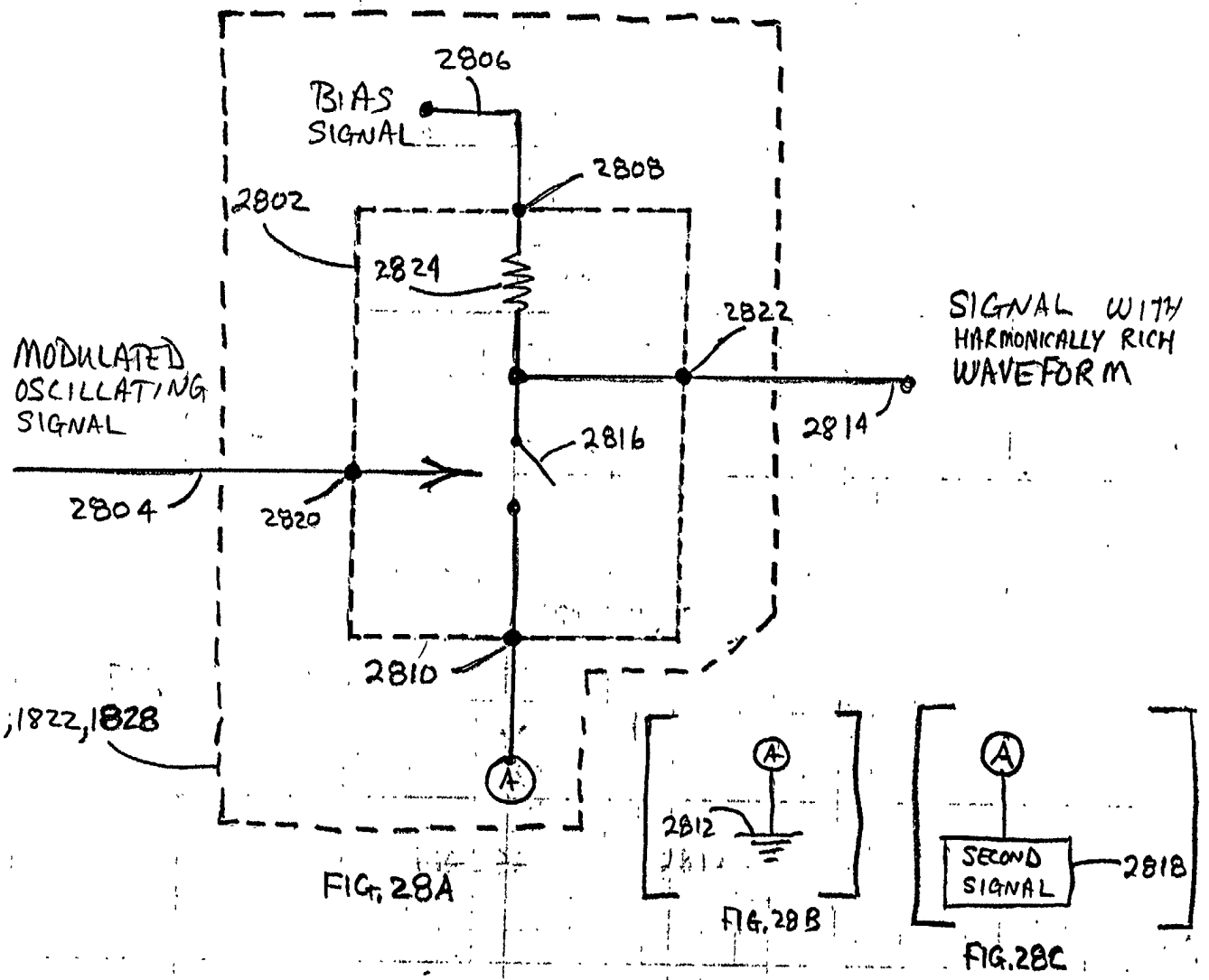


FIG. 28A

FIG. 28B

FIG. 28C

FIG. 28

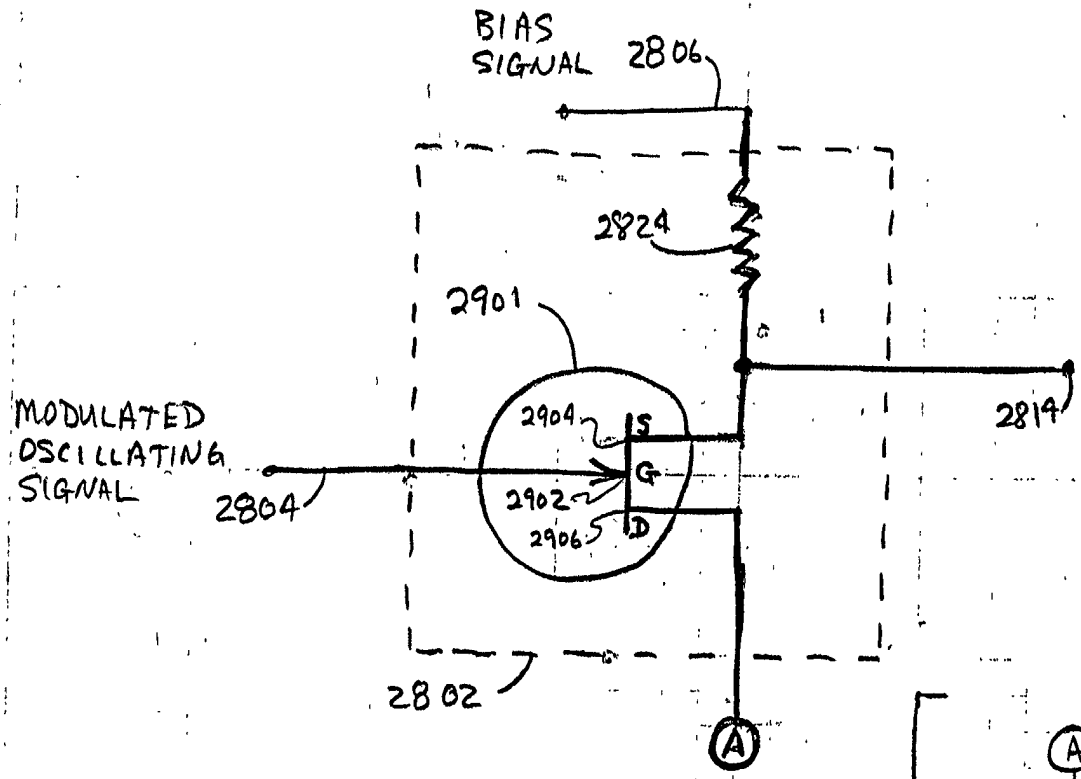


FIG. 29A

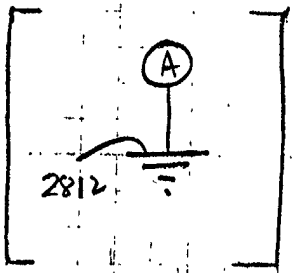


FIG. 29B

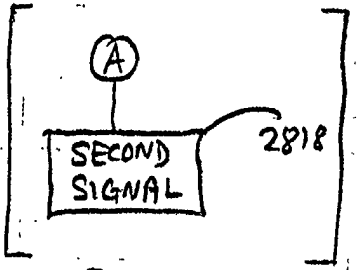


FIG. 29C

FIG. 29

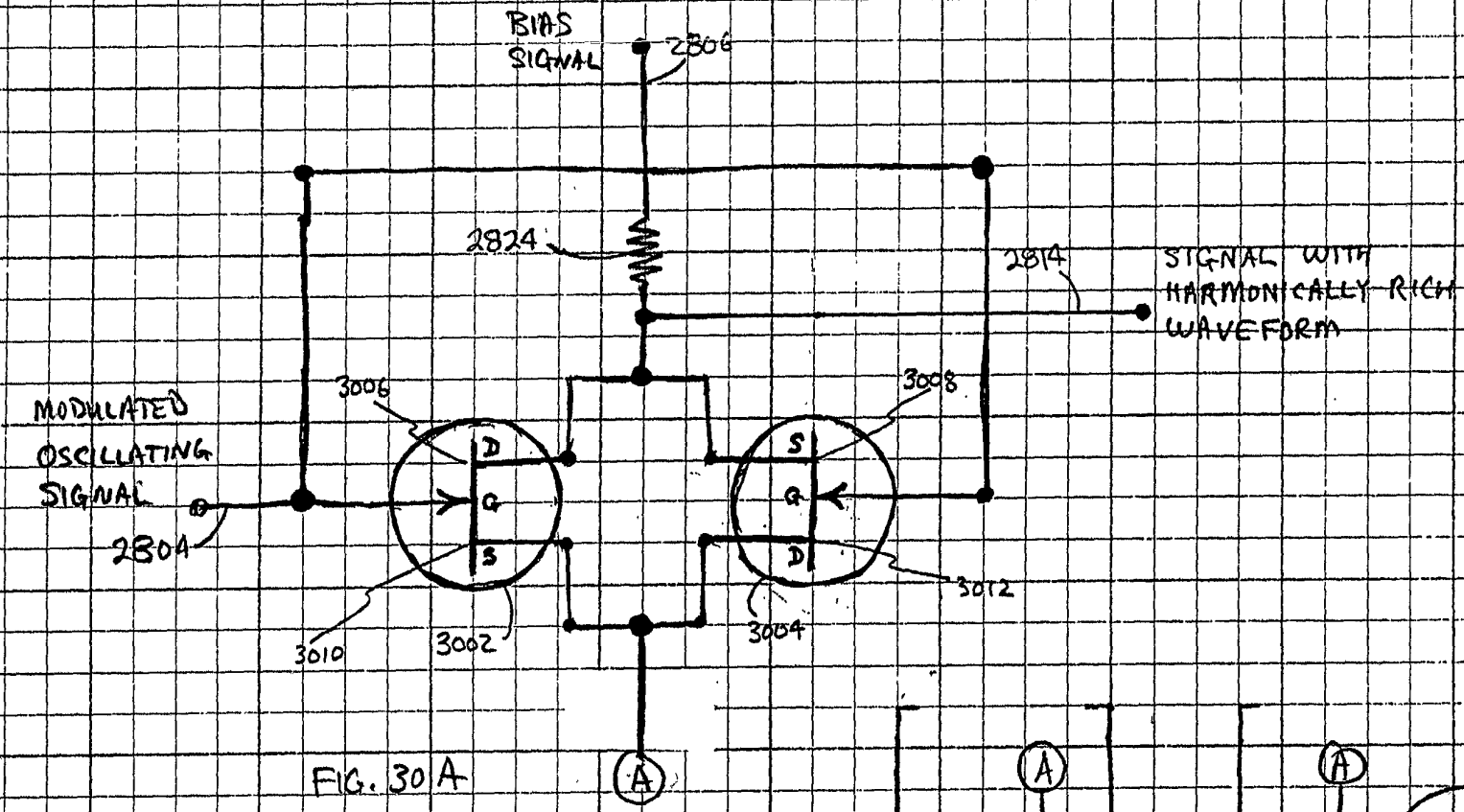


FIG. 30A

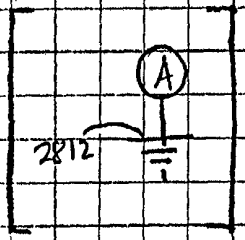


FIG. 30B

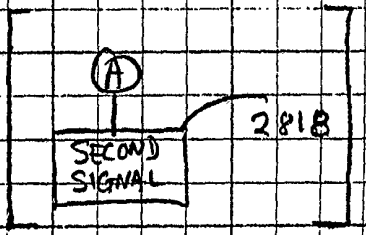


FIG. 30C

FIG. 30

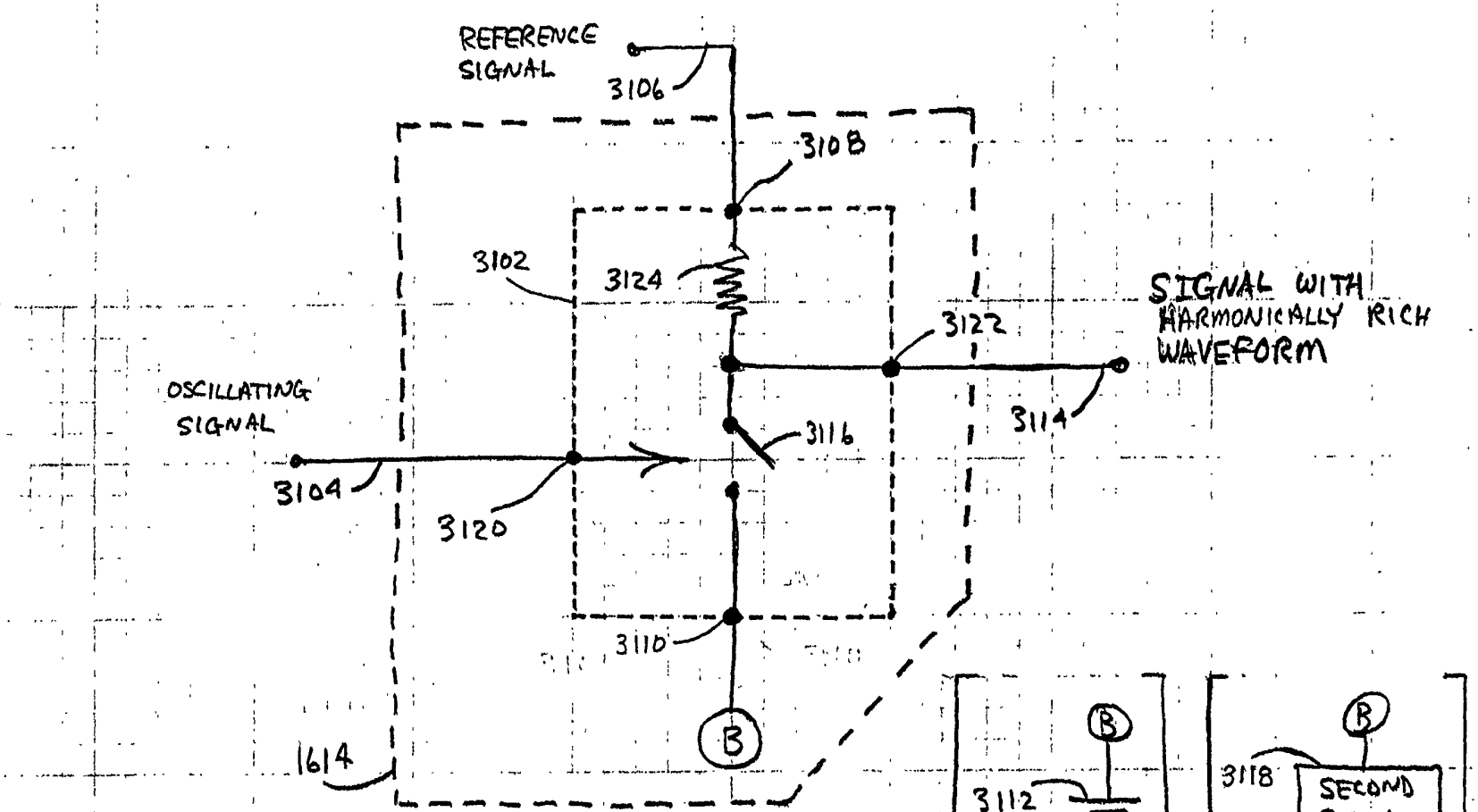


FIG. 31A

FIG. 31B

FIG. 31C

FIG. 31

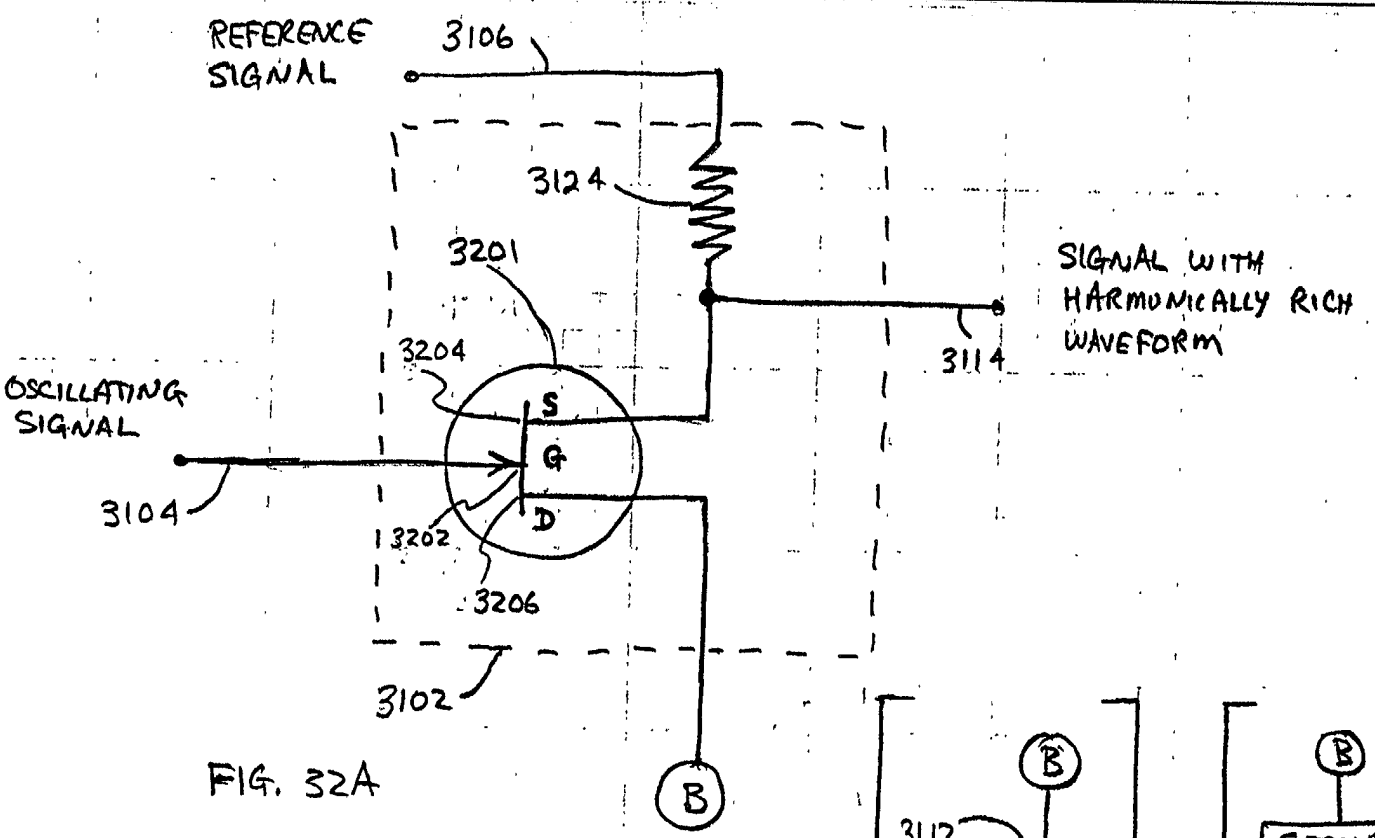


FIG. 32A

FIG. 32B

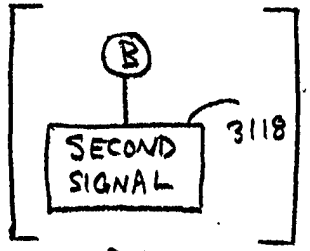


FIG. 32C

FIG. 32

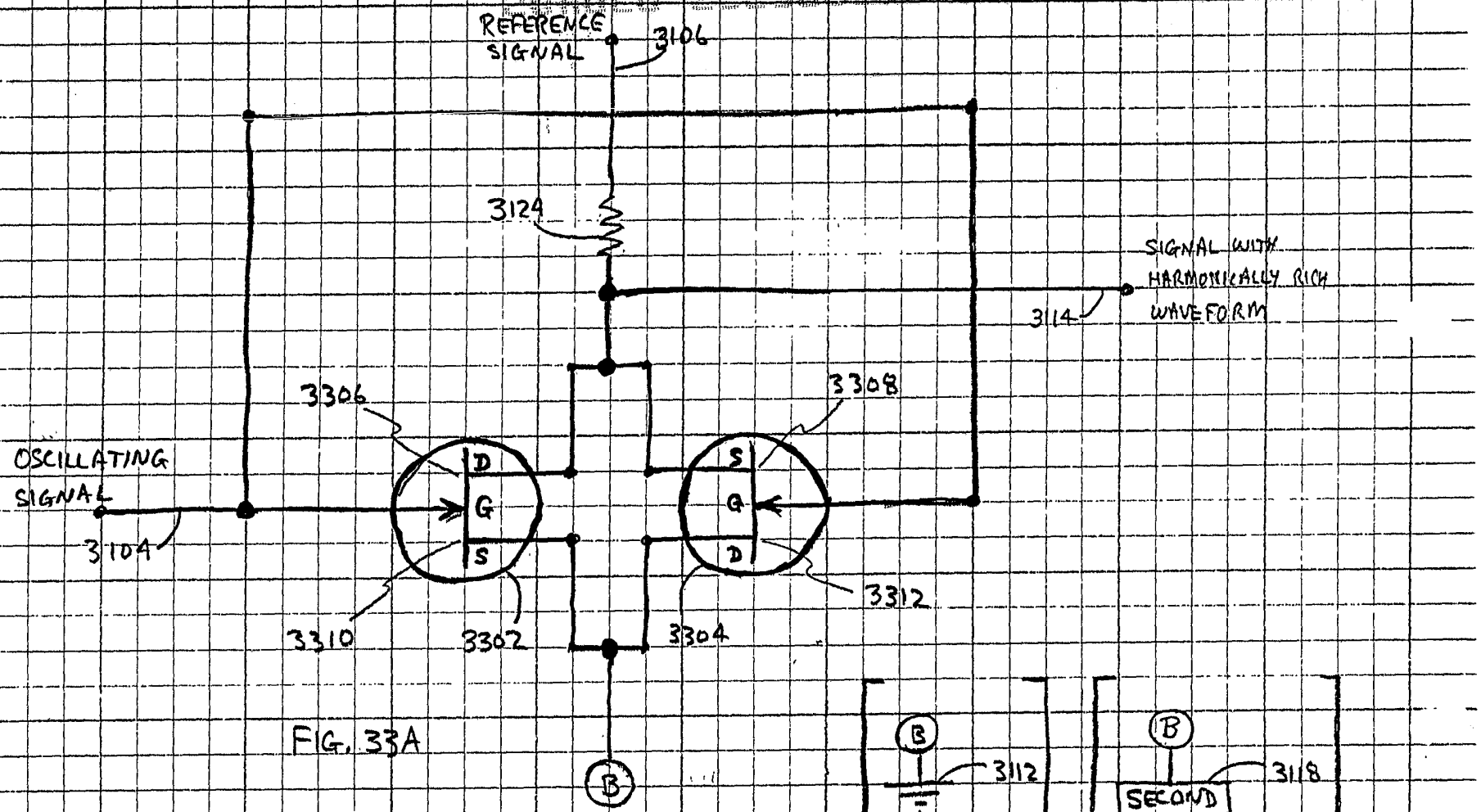


FIG. 33A

FIG. 33B

FIG. 33C

FIG. 33

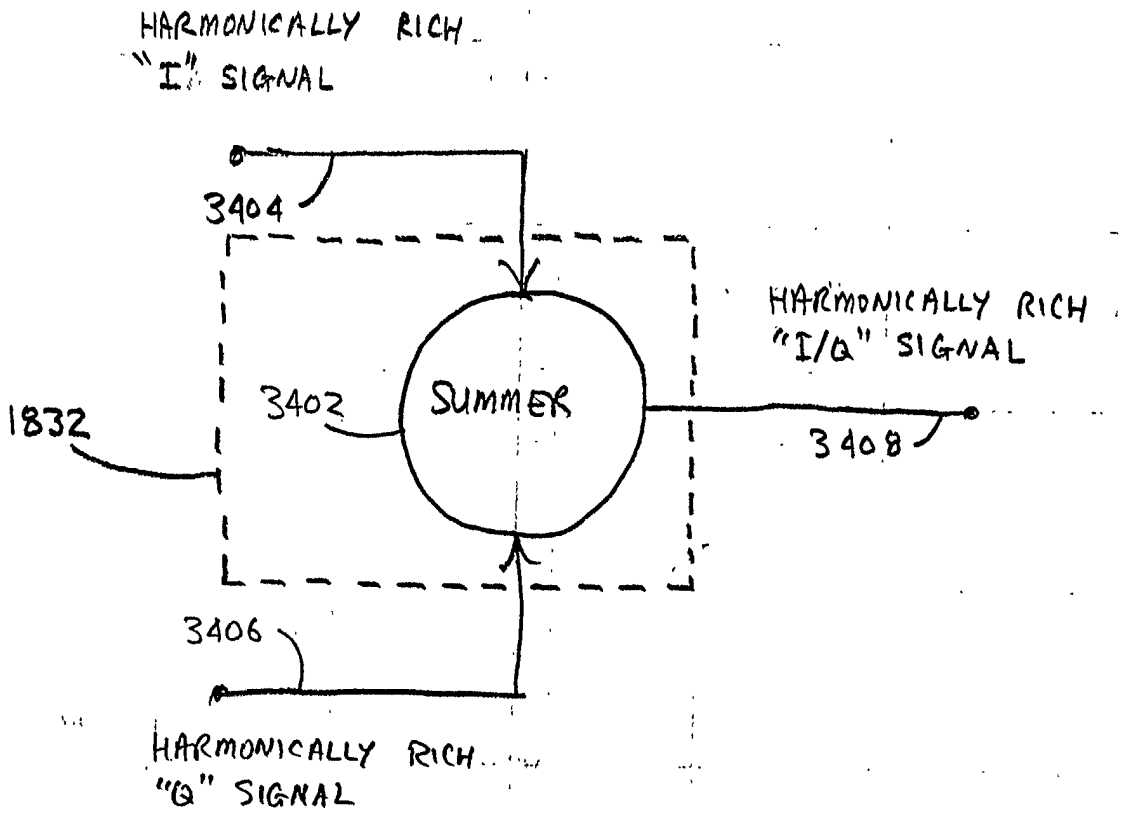


FIG. 34

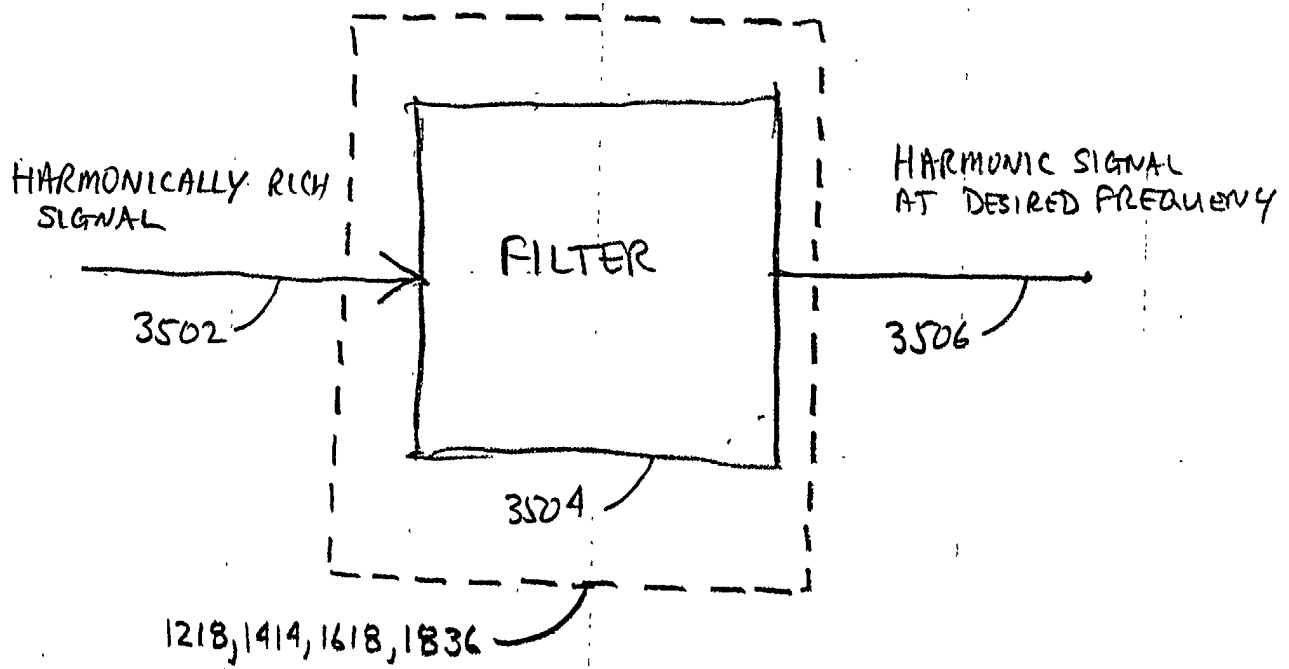


FIG 35

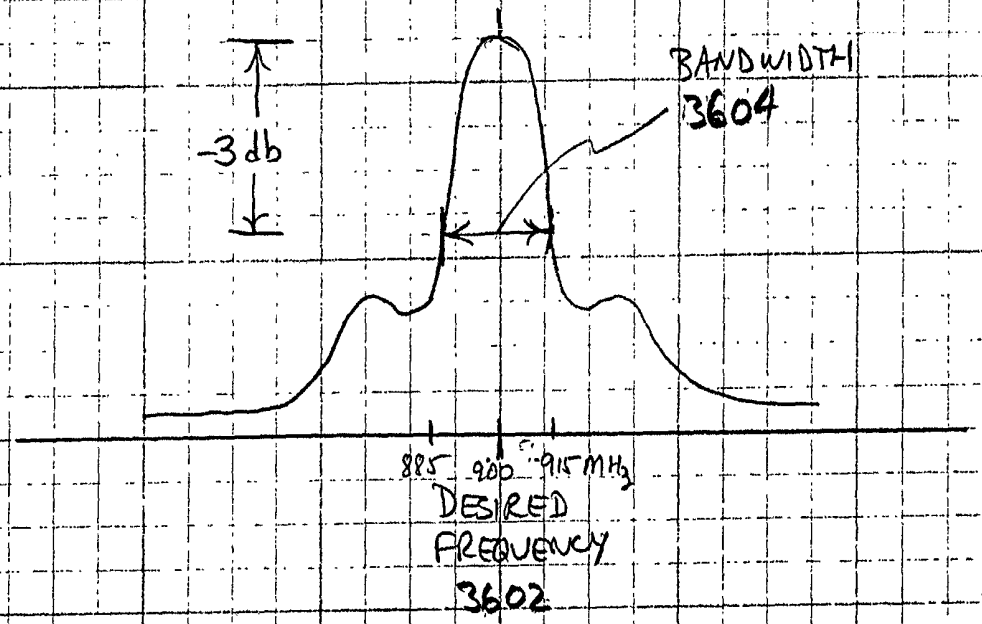


FIG 36

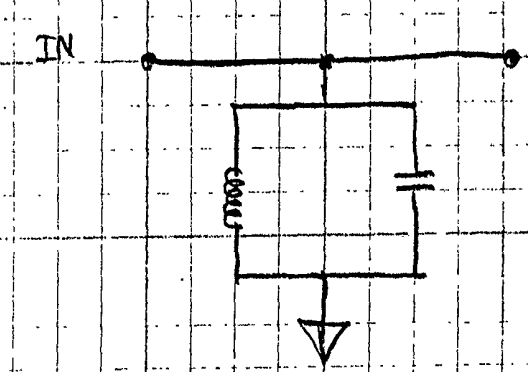


FIG. 37A

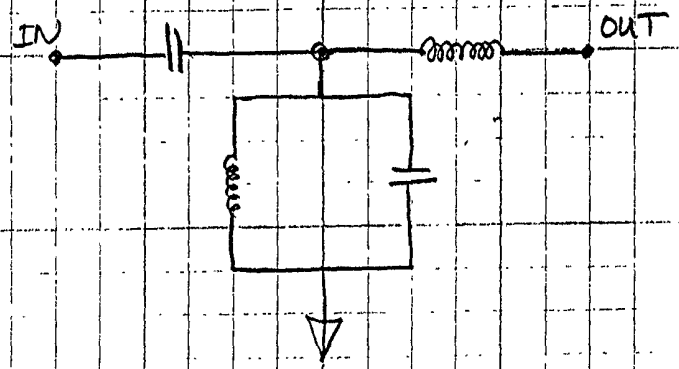


FIG. 37B

FIG. 37

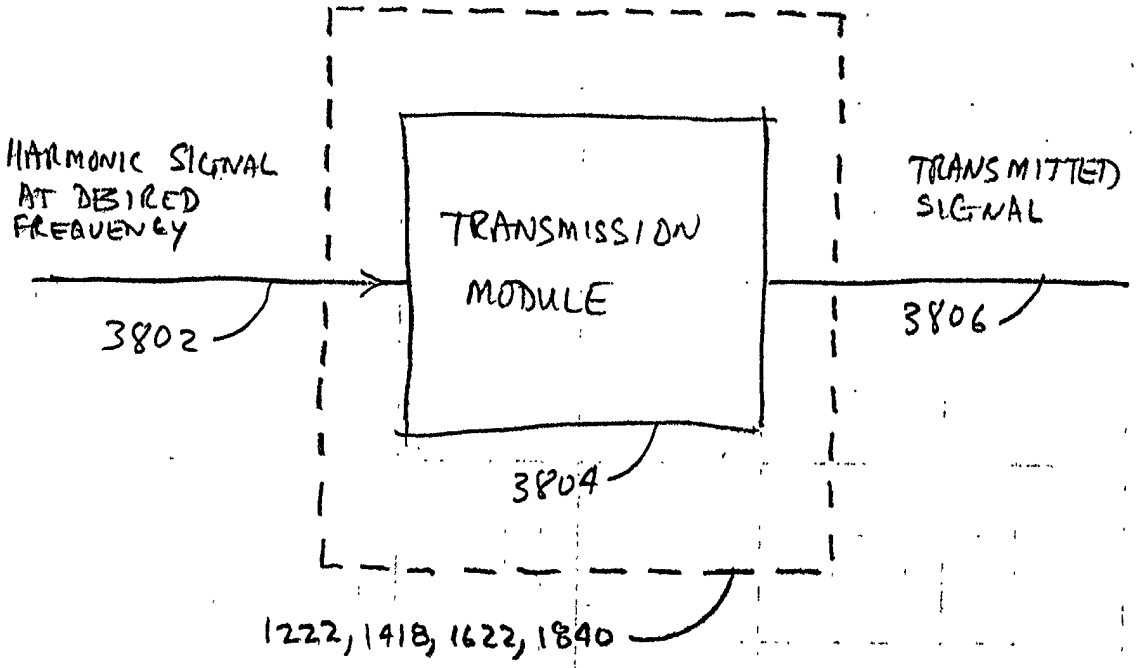


FIG. 38

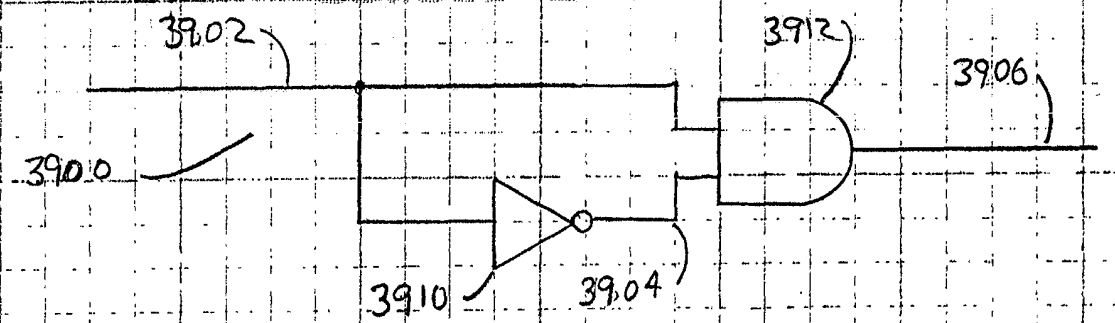


FIG. 39A

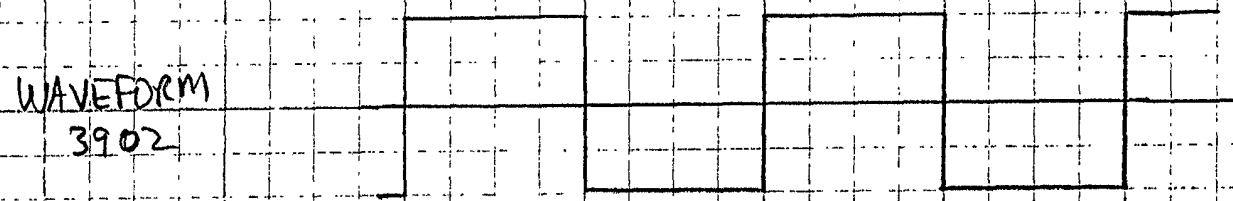


FIG. 39B

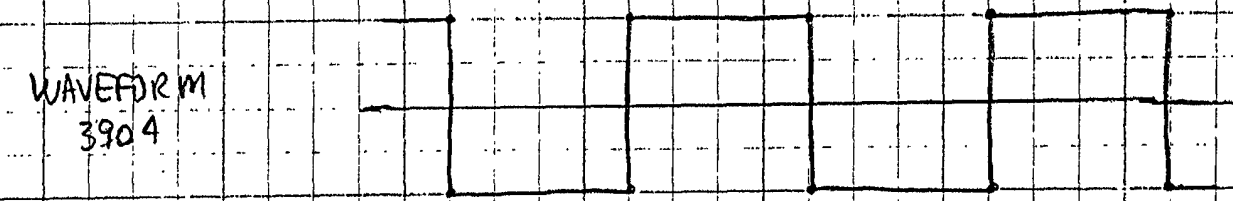


FIG. 39C

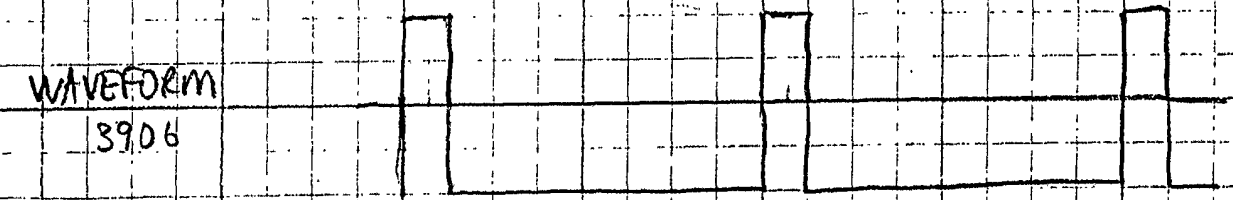


FIG. 39D

FIG. 39

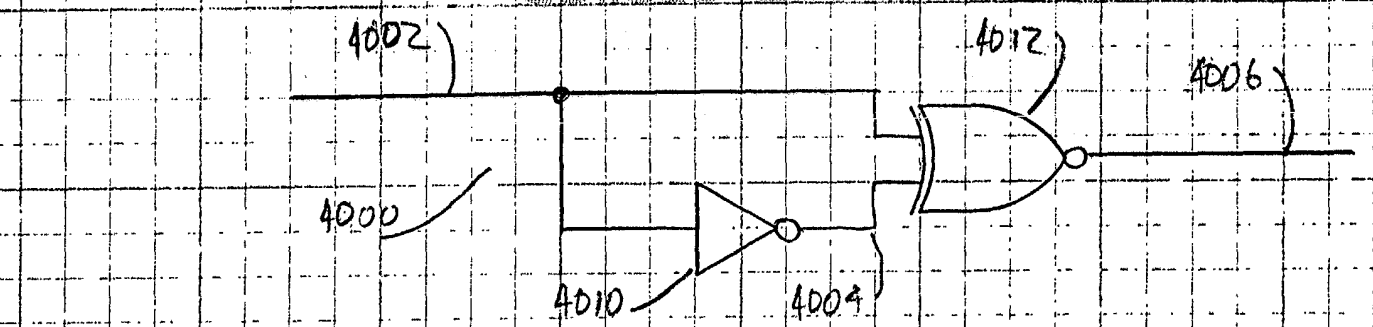


FIG. 40A

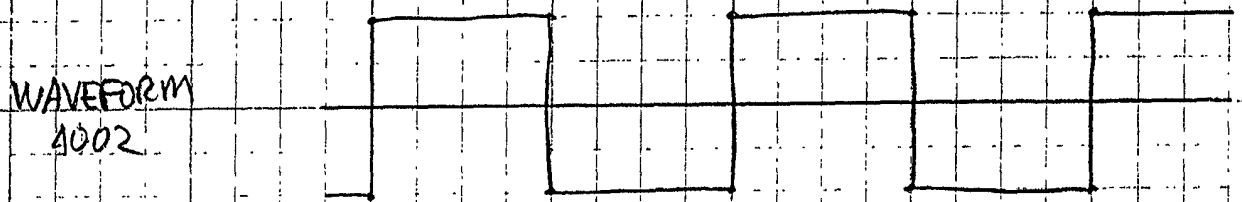


FIG. 40B

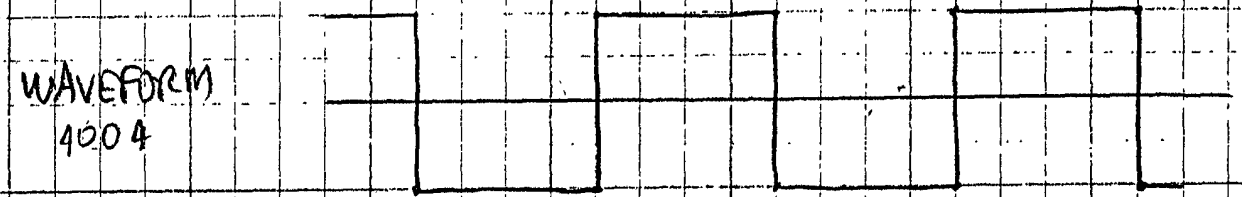


FIG. 40C

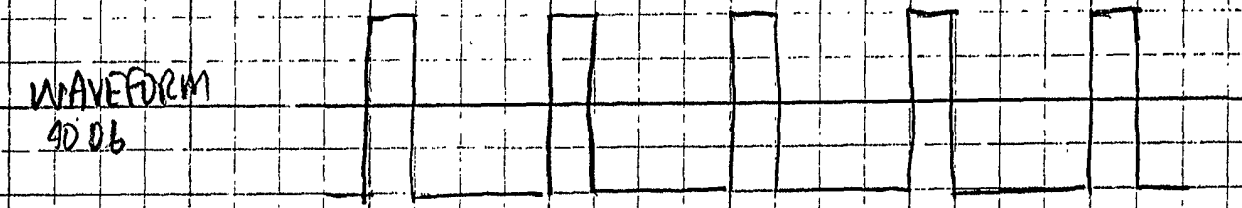


FIG. 40D

FIG. 40

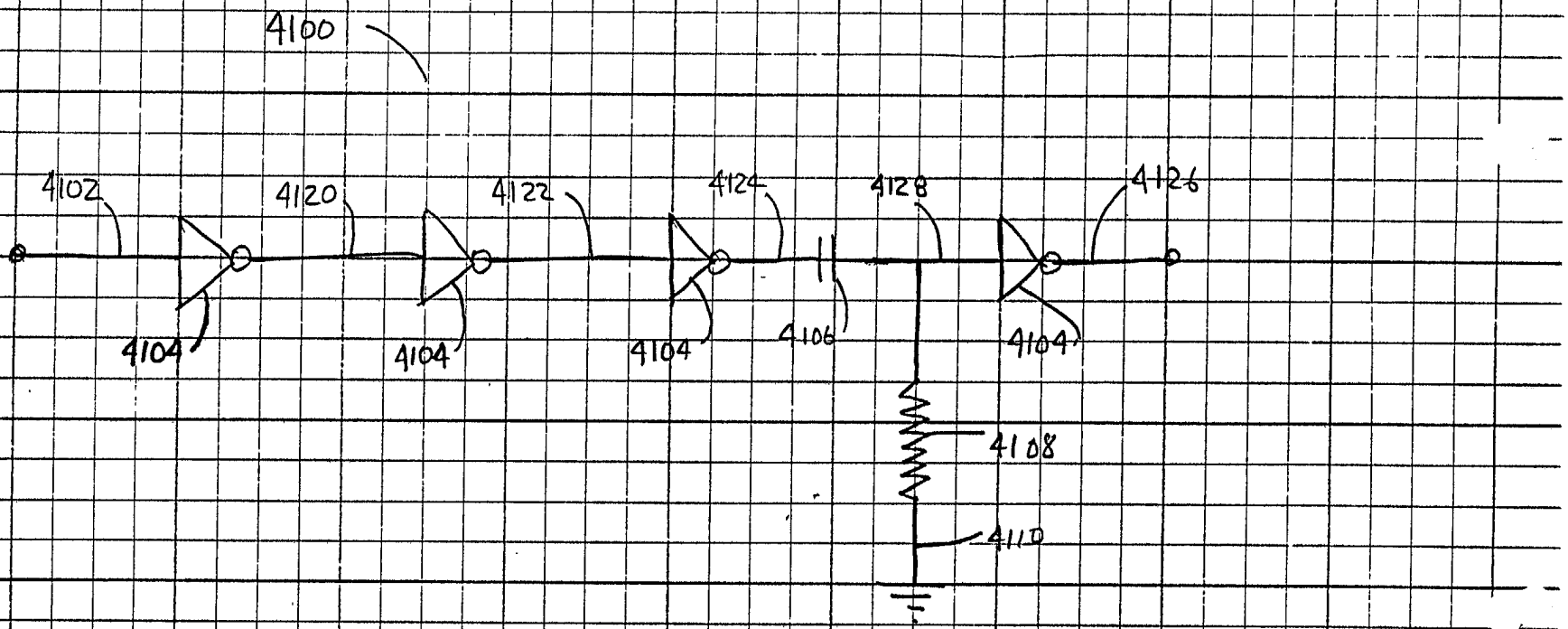

4100
4102
4120
4122
4124
4128
4126
4104
4104
4104
4106
4104
4108
4110

FIG. 41

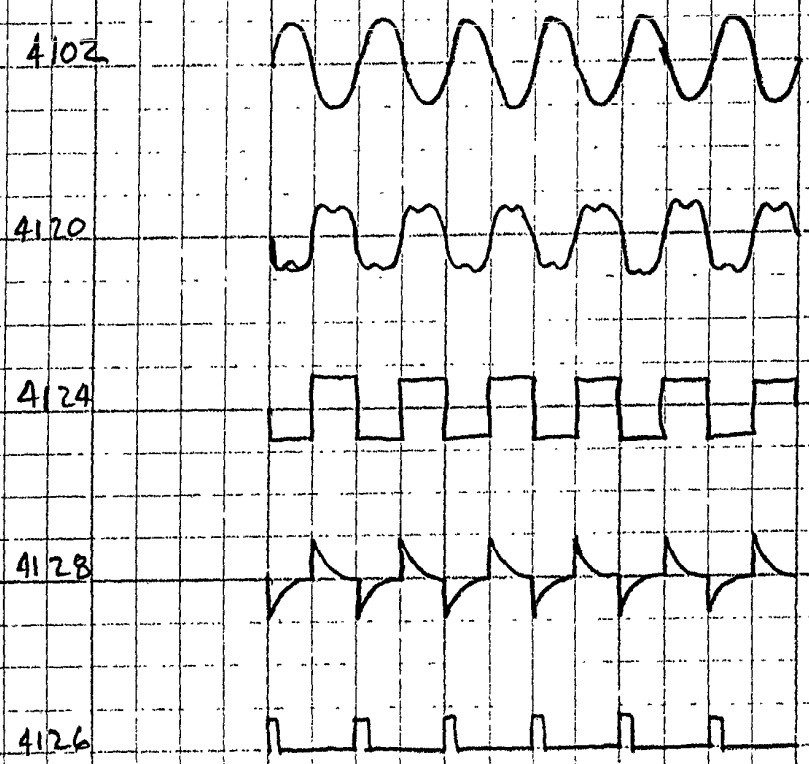


FIG. 42A

FIG. 42B

FIG. 42C

FIG. 42D

FIG. 42E

FIG. 42

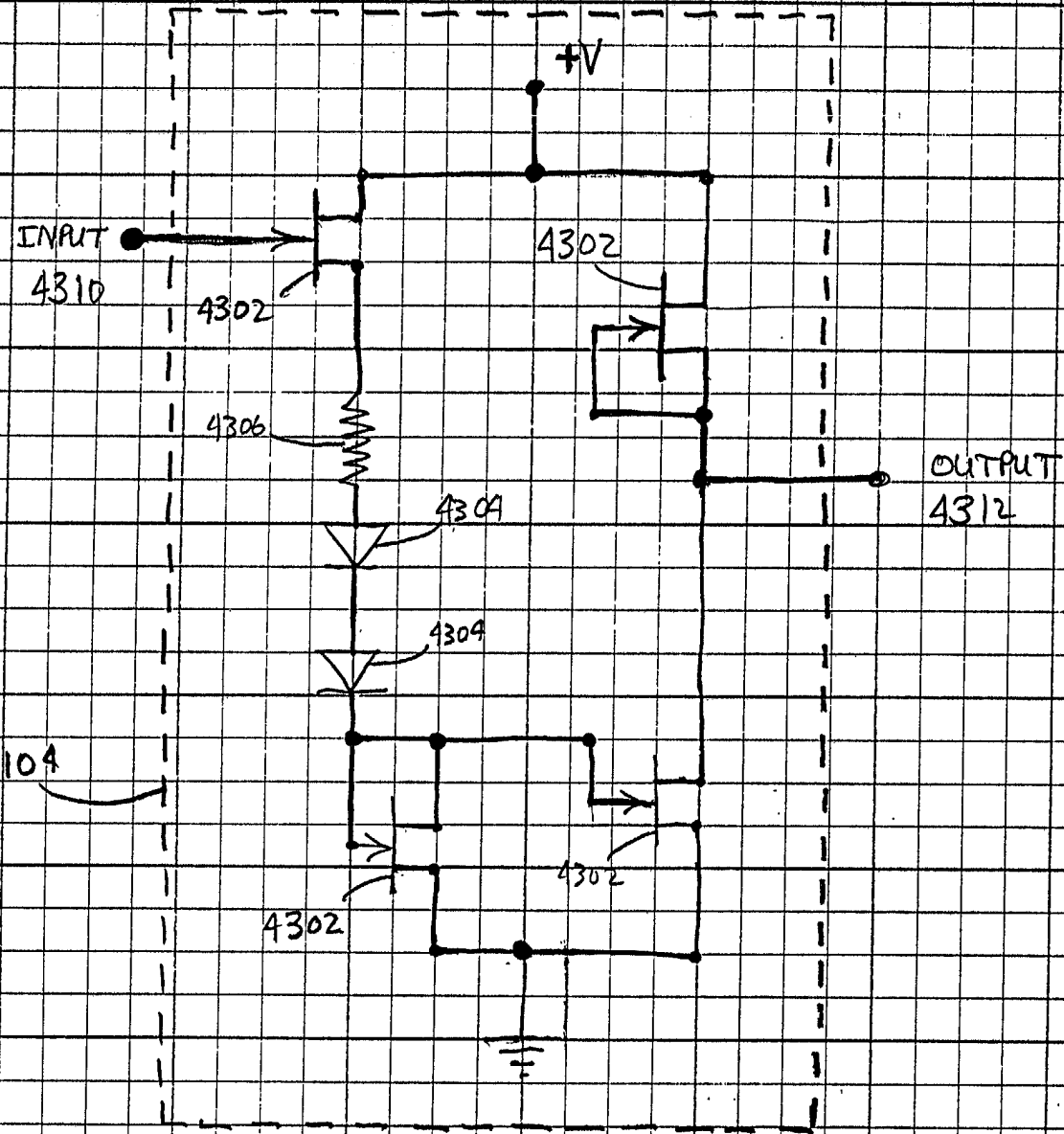

+V
INPUT
4310
4302
4302
4306
OUTPUT
4312
4304
4304
4104
4302
4302

FIG. 43

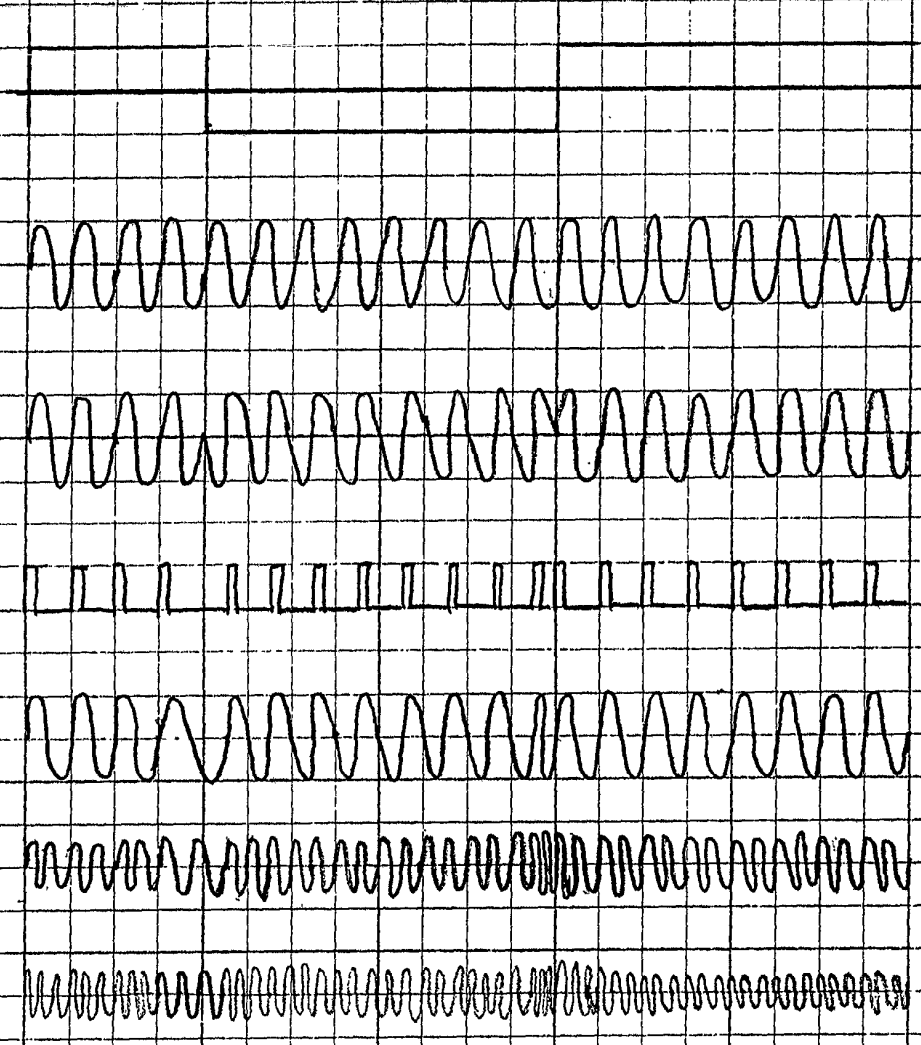


FIG. 44A

FIG. 44B

FIG. 44C

FIG. 44D

FIG. 44E

FIG. 44F

FIG. 44G

EXAMPLE WAVEFORMS IN A PHASE MODULATION EMBODIMENT

FIG. 44

INFORMATION SIGNAL 4502

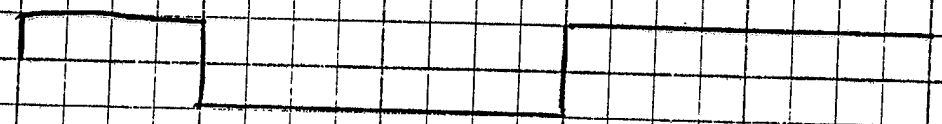


FIG. 45A

CARRIER SIGNAL 4504

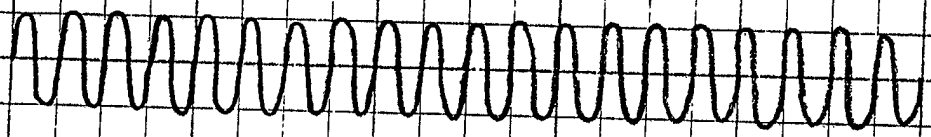


FIG. 45B

HARMONICALLY RICH SIGNAL 4506

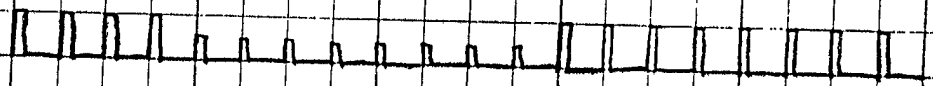


FIG. 45C

FUNDAMENTAL HARMONIC 4510

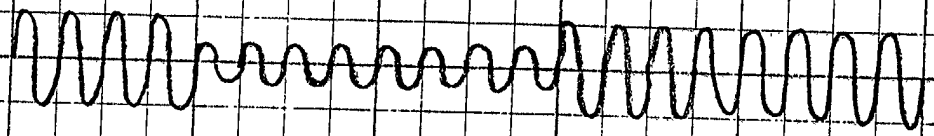


FIG. 45D

SECOND HARMONIC 4512

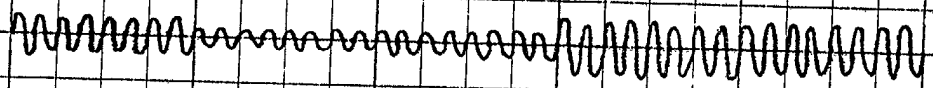


FIG. 45E

THIRD HARMONIC 4514

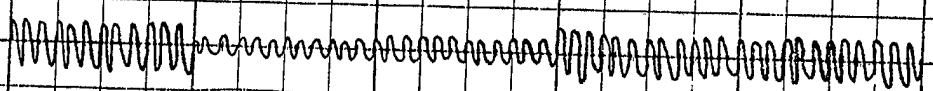


FIG. 45F

EXAMPLE WAVEFORMS IN AN AMPLITUDE MODULATION EMBODIMENT

FIG. 45

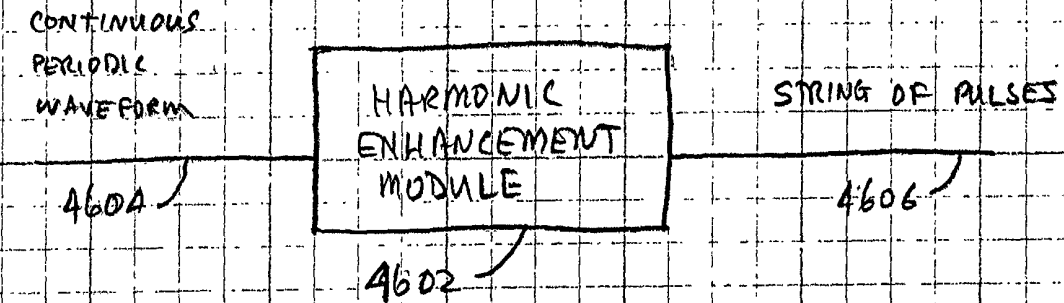

CONTINUOUS PERIODIC WAVEFORM
4604
HARMONIC ENHANCEMENT MODULE
4602
STRING OF PULSES
4606

FIG. 46

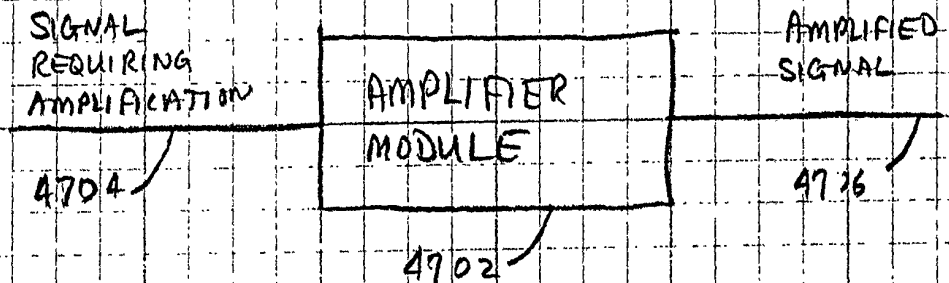

SIGNAL REQUIRING AMPLIFICATION
4704
AMPLIFIER MODULE
4702
AMPLIFIED SIGNAL
4706

FIG. 47

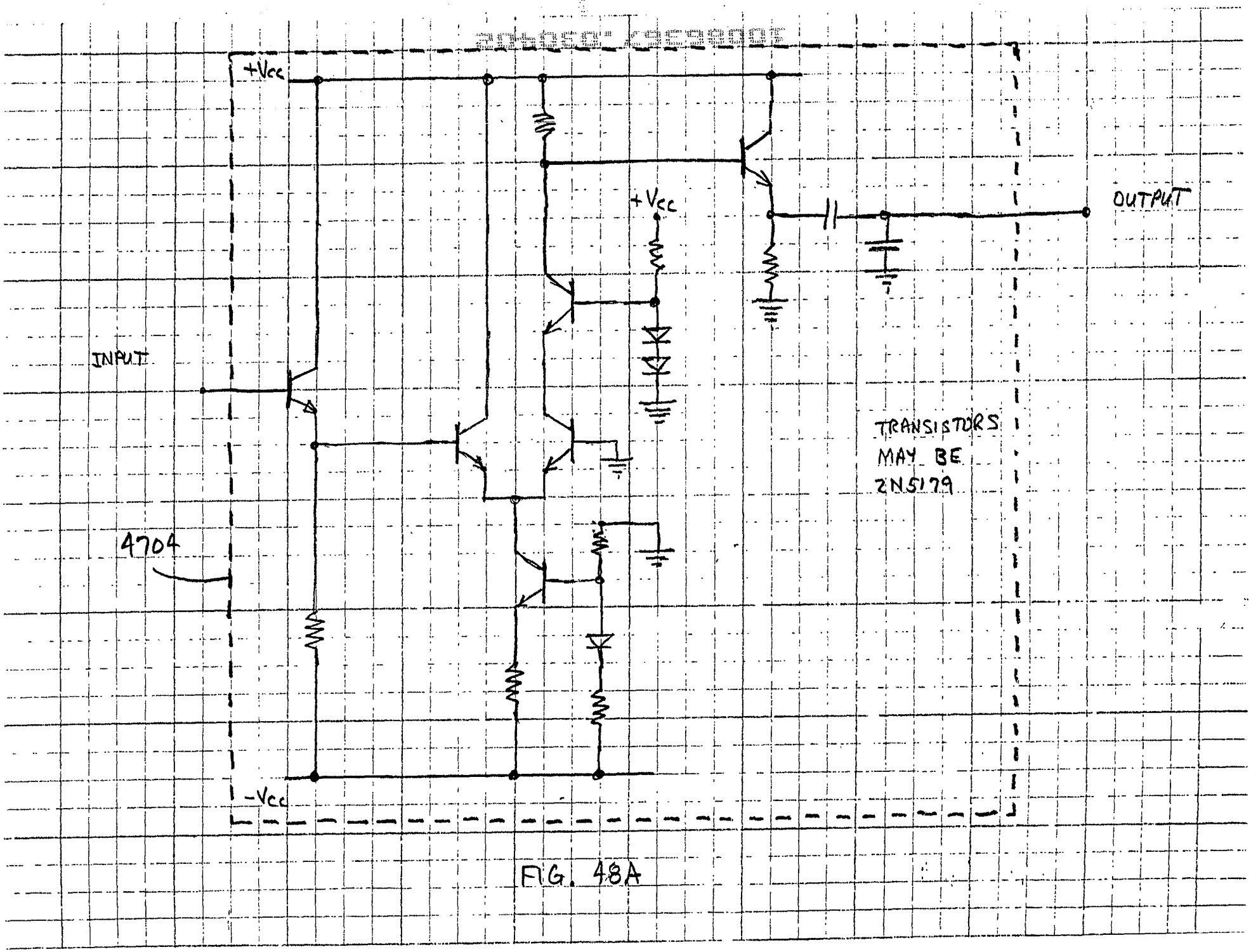


FIG. 48A

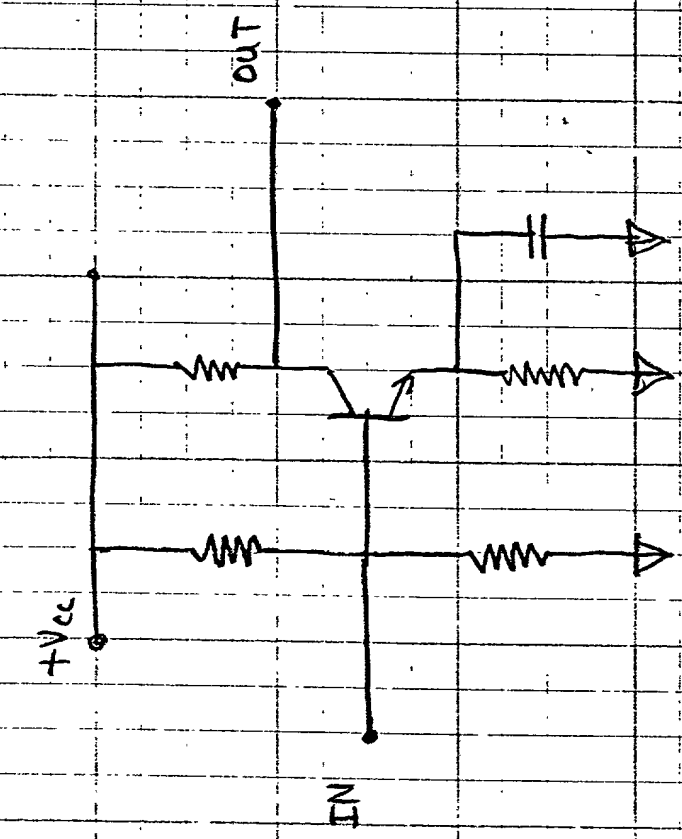


FIG. 48B

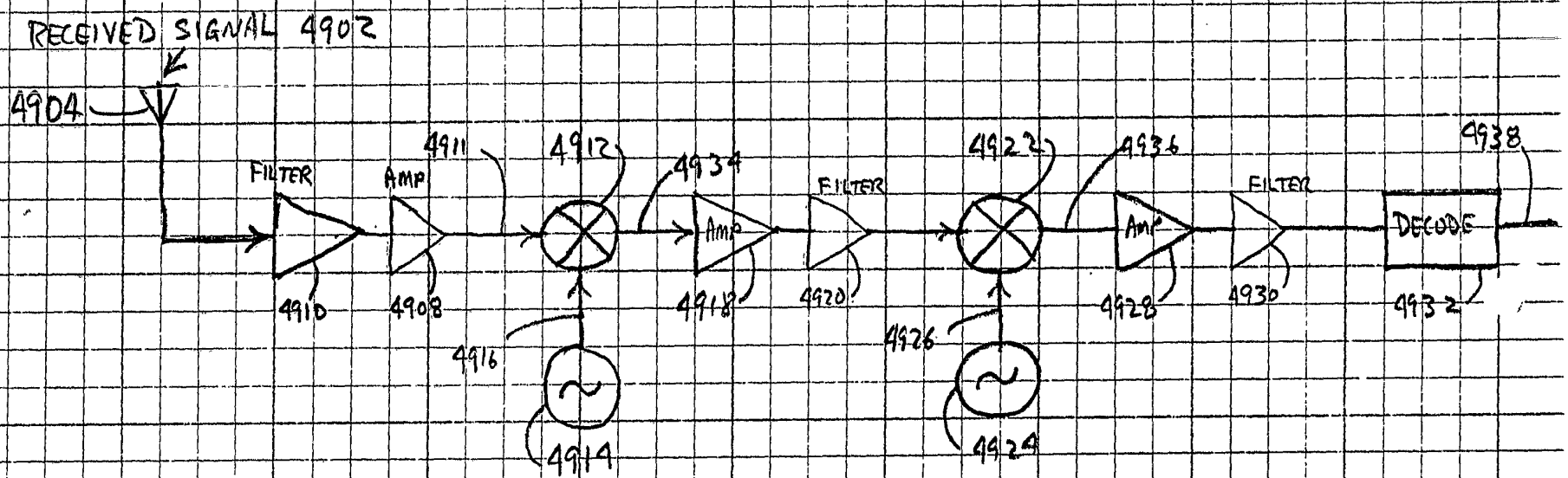

RECEIVED SIGNAL 4902
4904
FILTER
4910
AMP
4908
4911
4912
4916
4914
4934
Amp
4918
FILTER
4920
4922
4926
4924
4936
Amp
4928
FILTER
4930
DECODE
4932
4938

FIG. 49

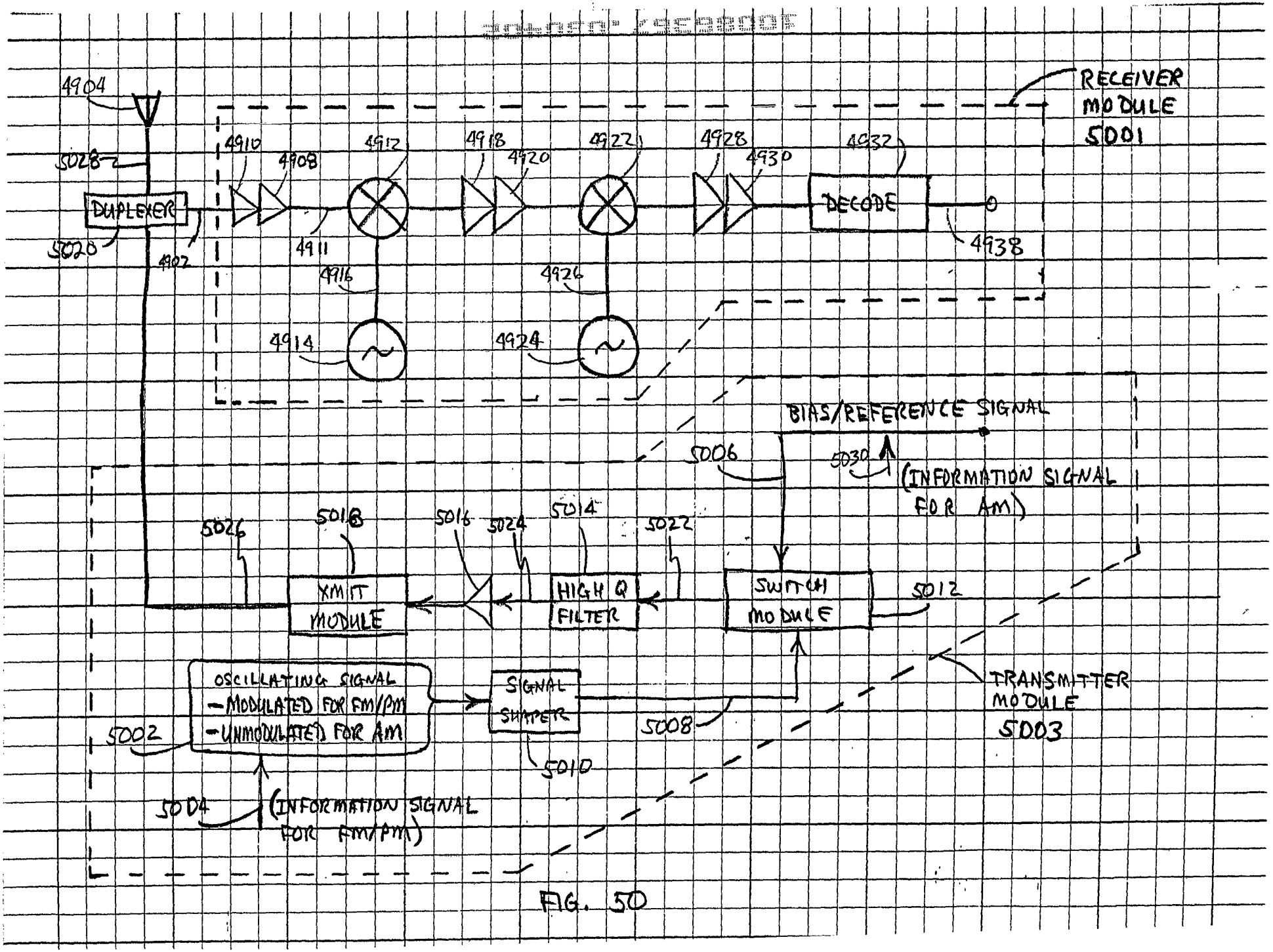

4904
5028
DUPLEXER
5020
4902
4910
4908
4911
4912
4916
4914
4918
4920
4922
4926
4924
4928
4930
4932
DECODE
4938
RECEIVER MODULE 5001
BIAS/REFERENCE SIGNAL
5006
5030
(INFORMATION SIGNAL FOR AM)
5026
5018
5016
5024
5014
5022
XMIT MODULE
HIGH Q FILTER
SWITCH MODULE
5012
OSCILLATING SIGNAL
- MODULATED FOR FM/PM
- UNMODULATED FOR AM
5002
SIGNAL SHAPER
5010
5008
TRANSMITTER MODULE 5003
5004
(INFORMATION SIGNAL FOR FM/PM)

FIG. 50

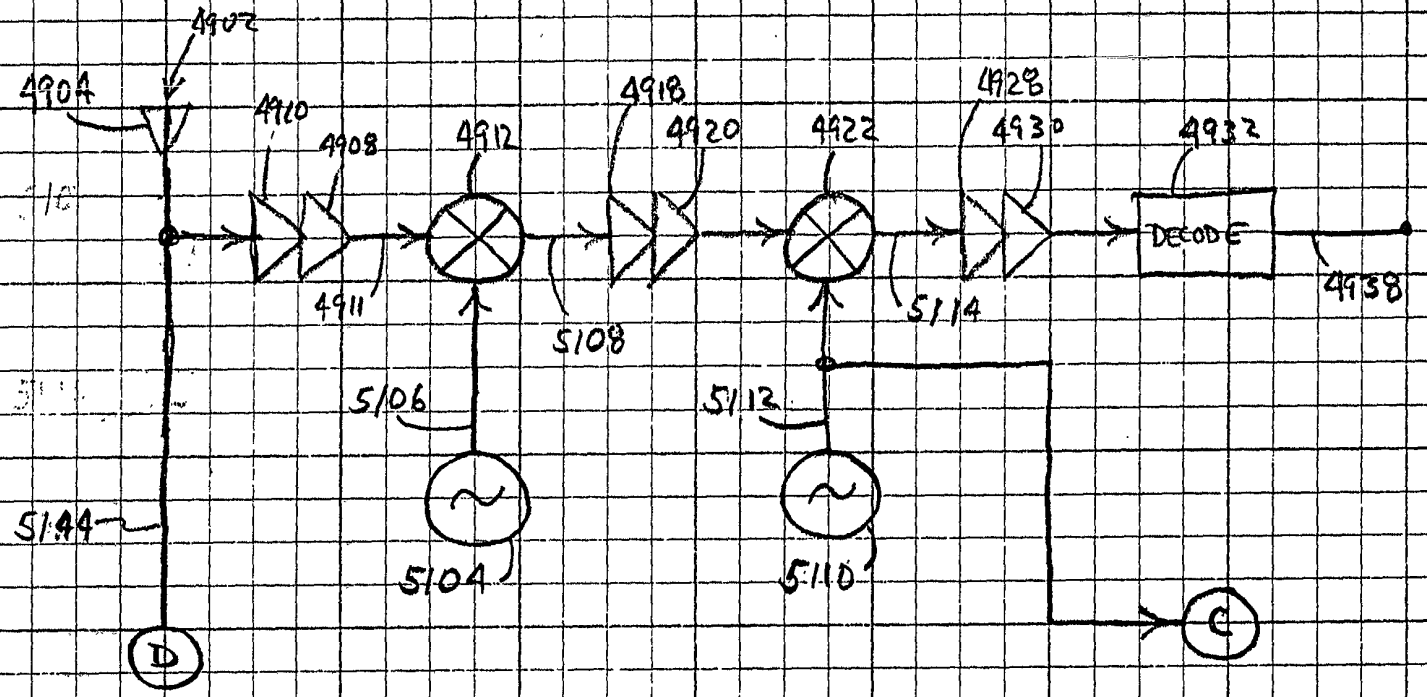

4902
4904
4910
4908
4912
4918
4920
4922
4928
4930
4932
DECODE
4938
4911
5108
5114
5106
5112
5104
5110
5144
D
C

FIG. 51A

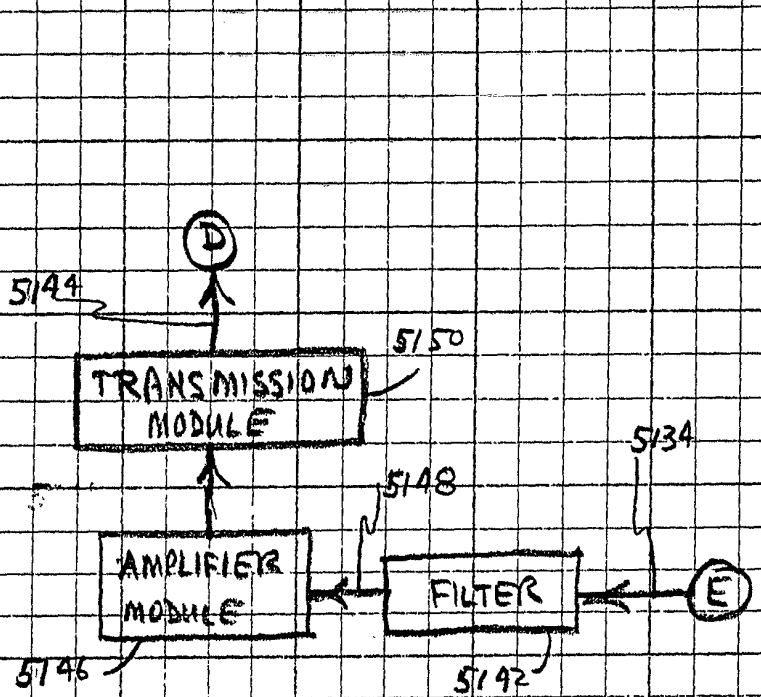


FIG. 51D

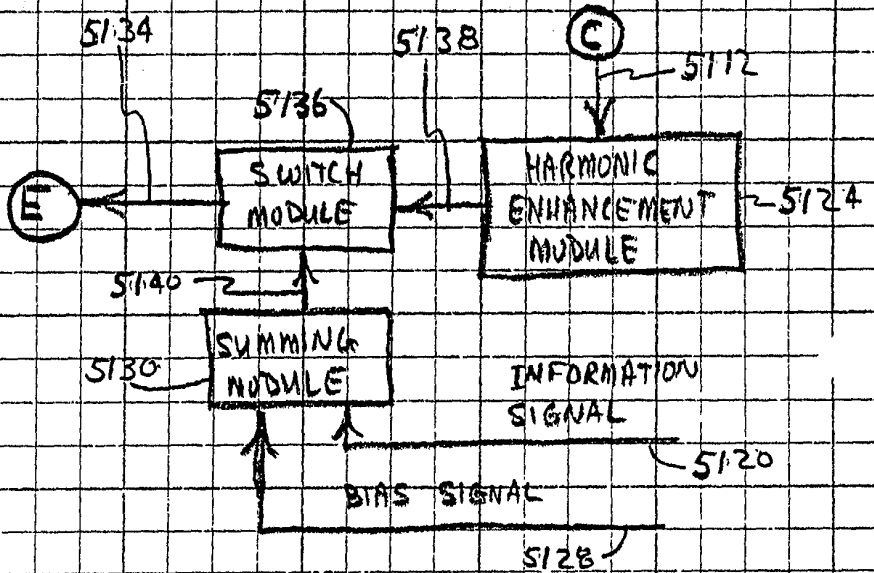


FIG. 51C

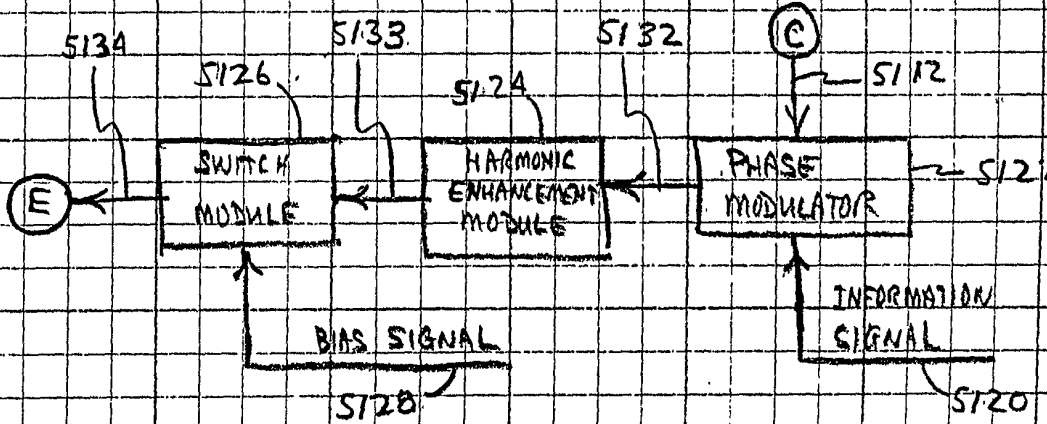
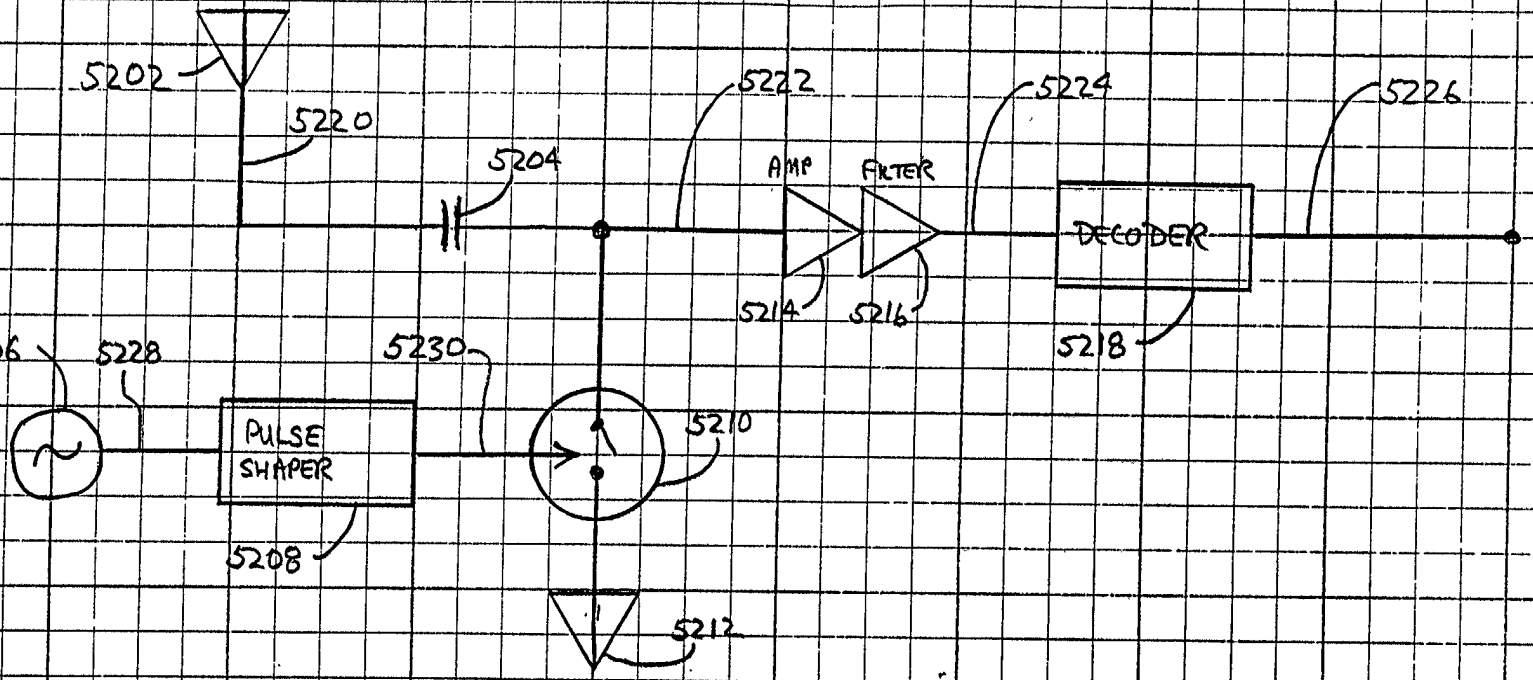
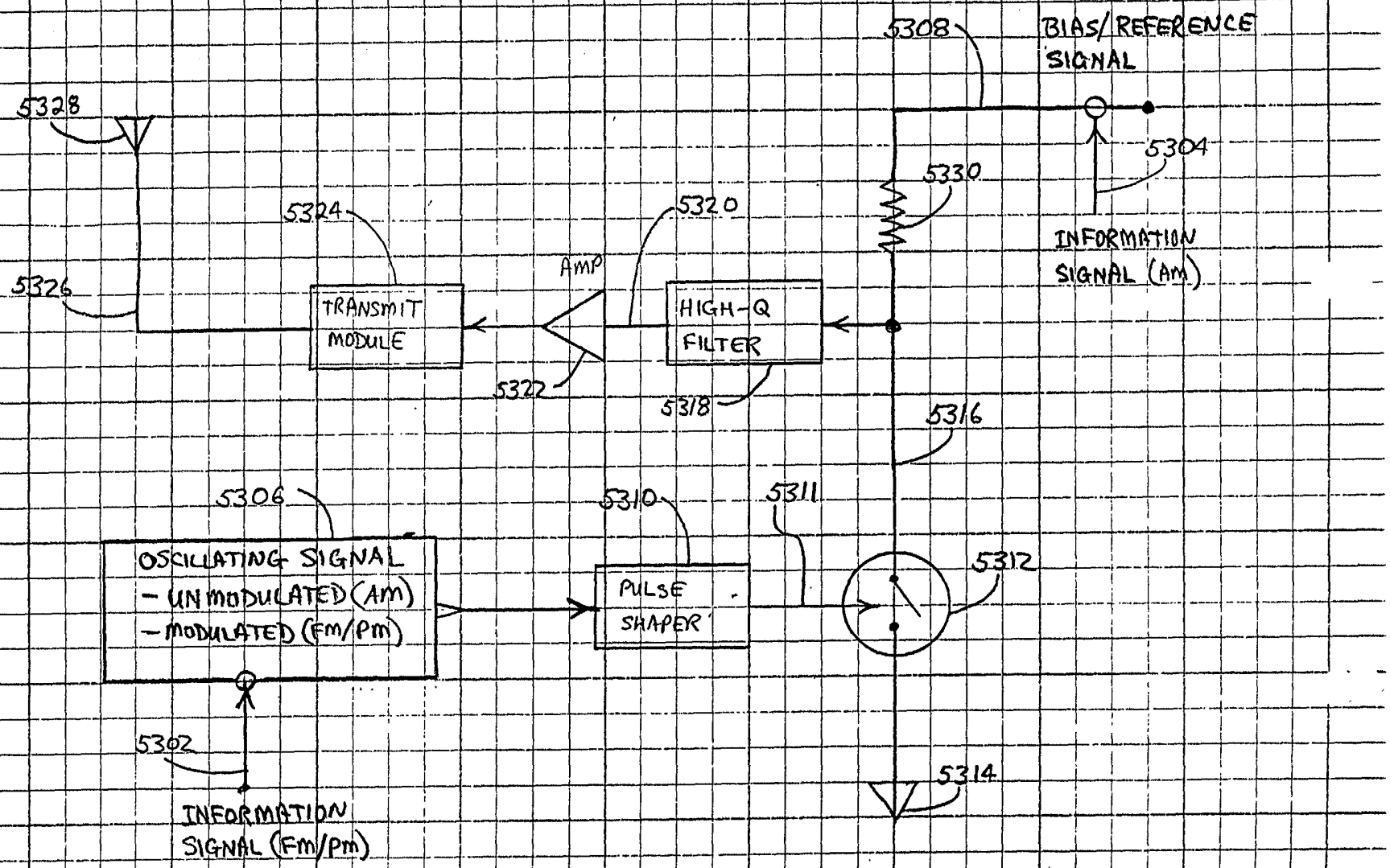


FIG. 51B



EXEMPLARY RECEIVER FOR UNIVERSAL FREQUENCY DOWN-CONVERSION

FIG. 52



EXEMPLARY TRANSMITTER USING THE PRESENT INVENTION

FIG. 53

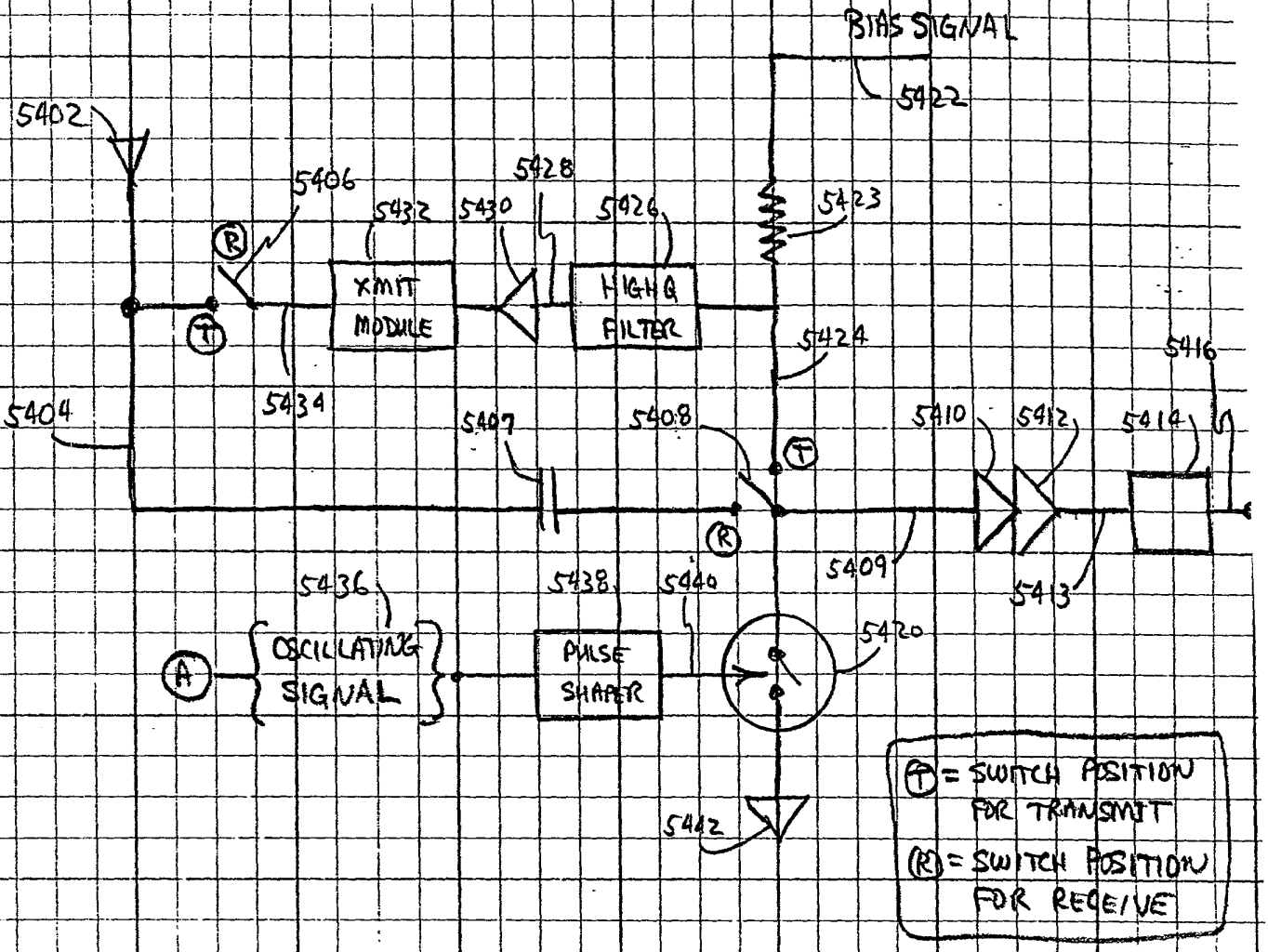


FIG. 54A – TRANSMITTER USING PRESENT INVENTION IN A HALF DUPLEX COMMUNICATIONS CIRCUIT WITH A UNIVERSAL FREQUENCY DOWN-CONVERTER (FM & PM)

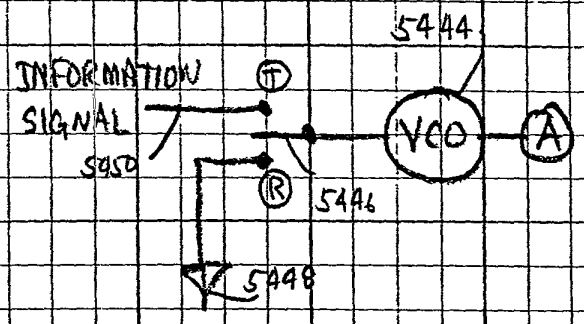
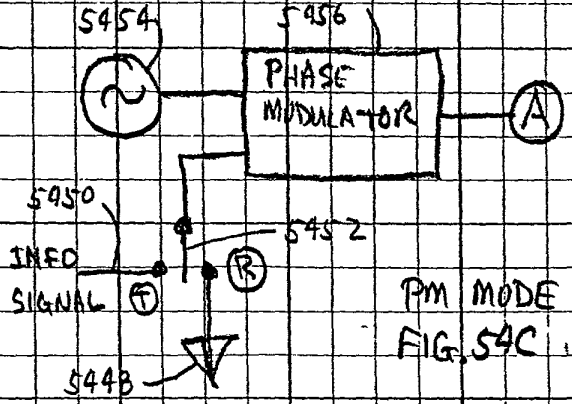


FIG. 54B – FM MODE



PM MODE
FIG. 54C

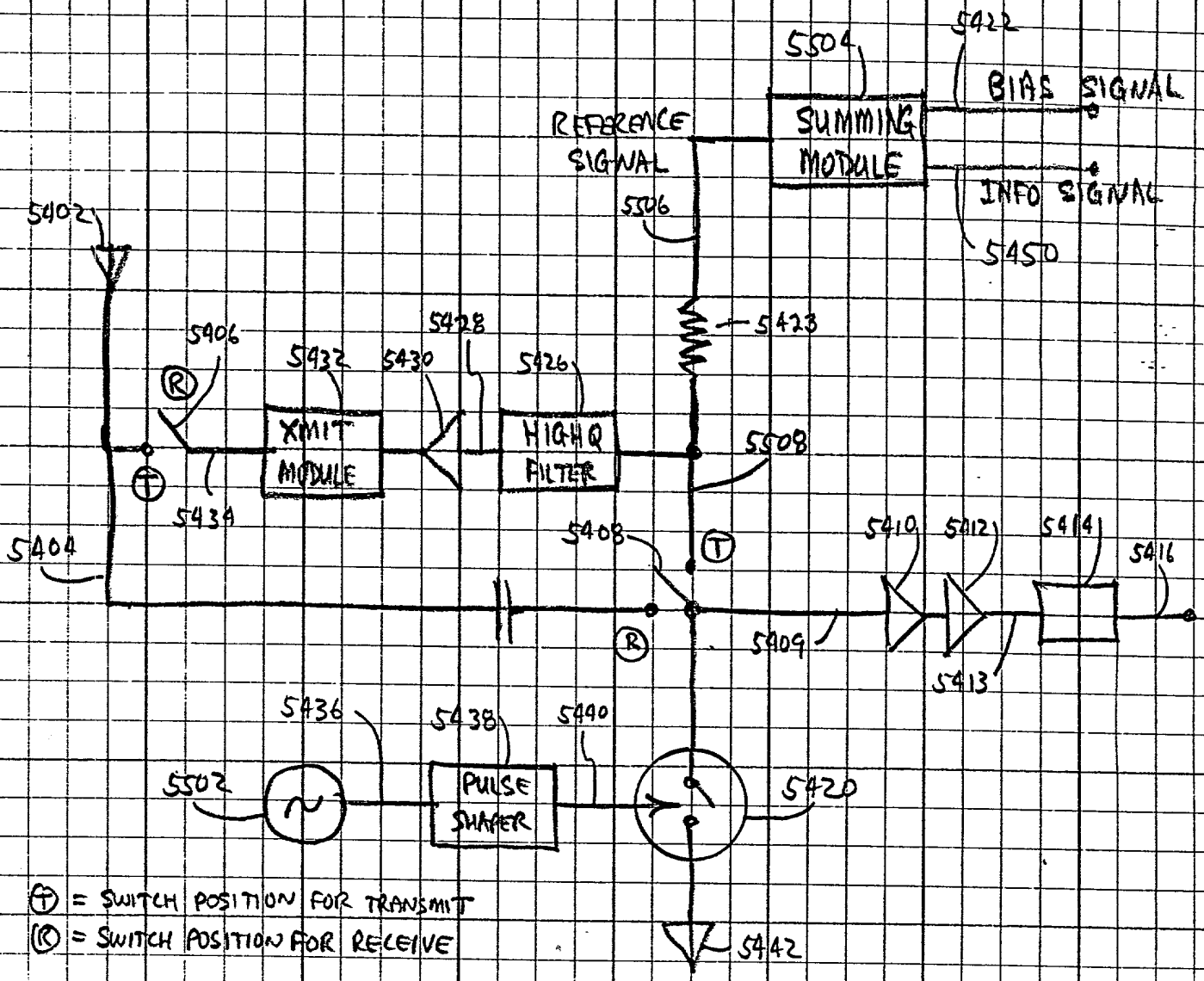


FIG. 55 – TRANSMITTER USING PRESENT INVENTION IN A HALF-DUPLEX COMMUNICATIONS CIRCUIT WITH A UNIVERSAL FREQUENCY DOWN-CONVERTER (AM)

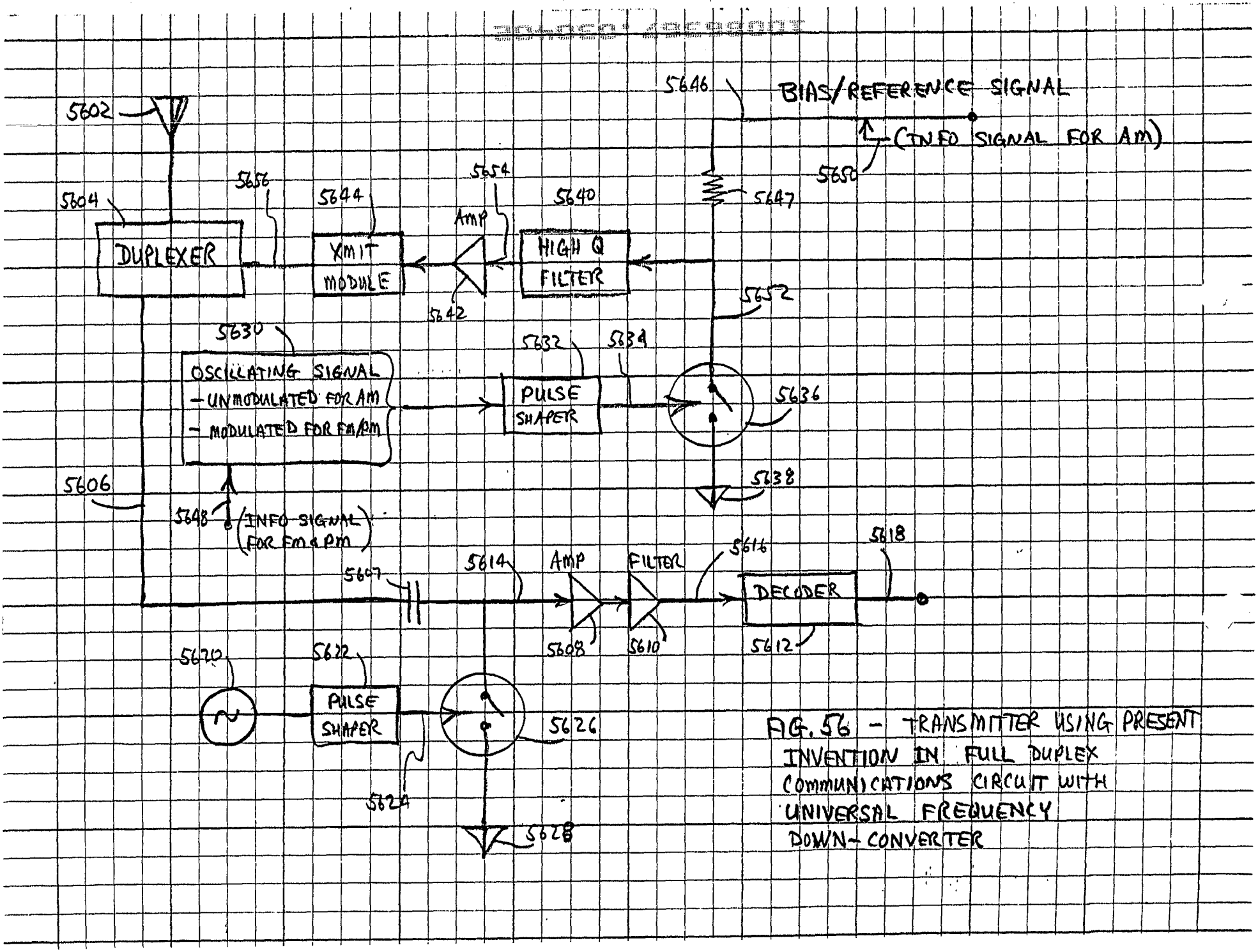
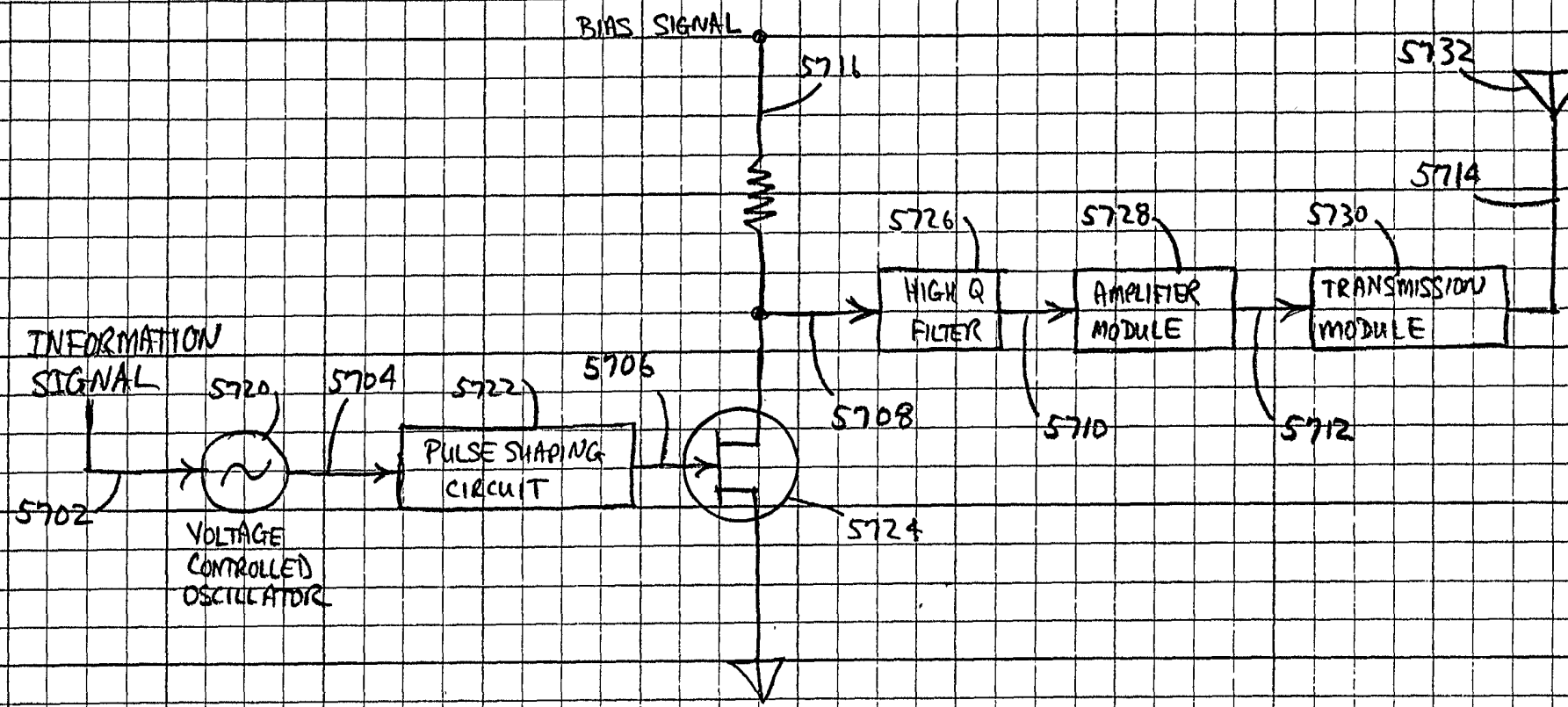
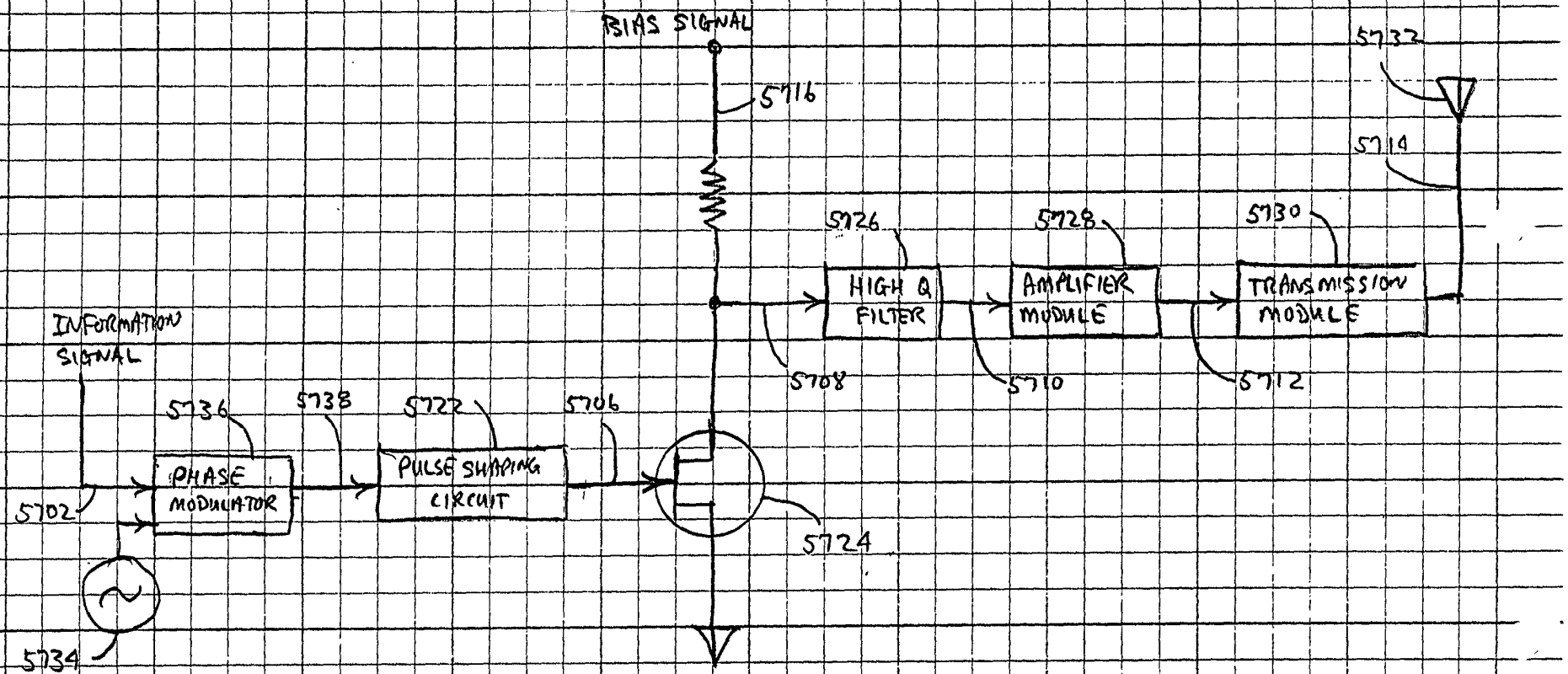


FIG. 56 - TRANSMITTER USING PRESENT INVENTION IN FULL DUPLEX COMMUNICATIONS CIRCUIT WITH UNIVERSAL FREQUENCY DOWN-CONVERTER



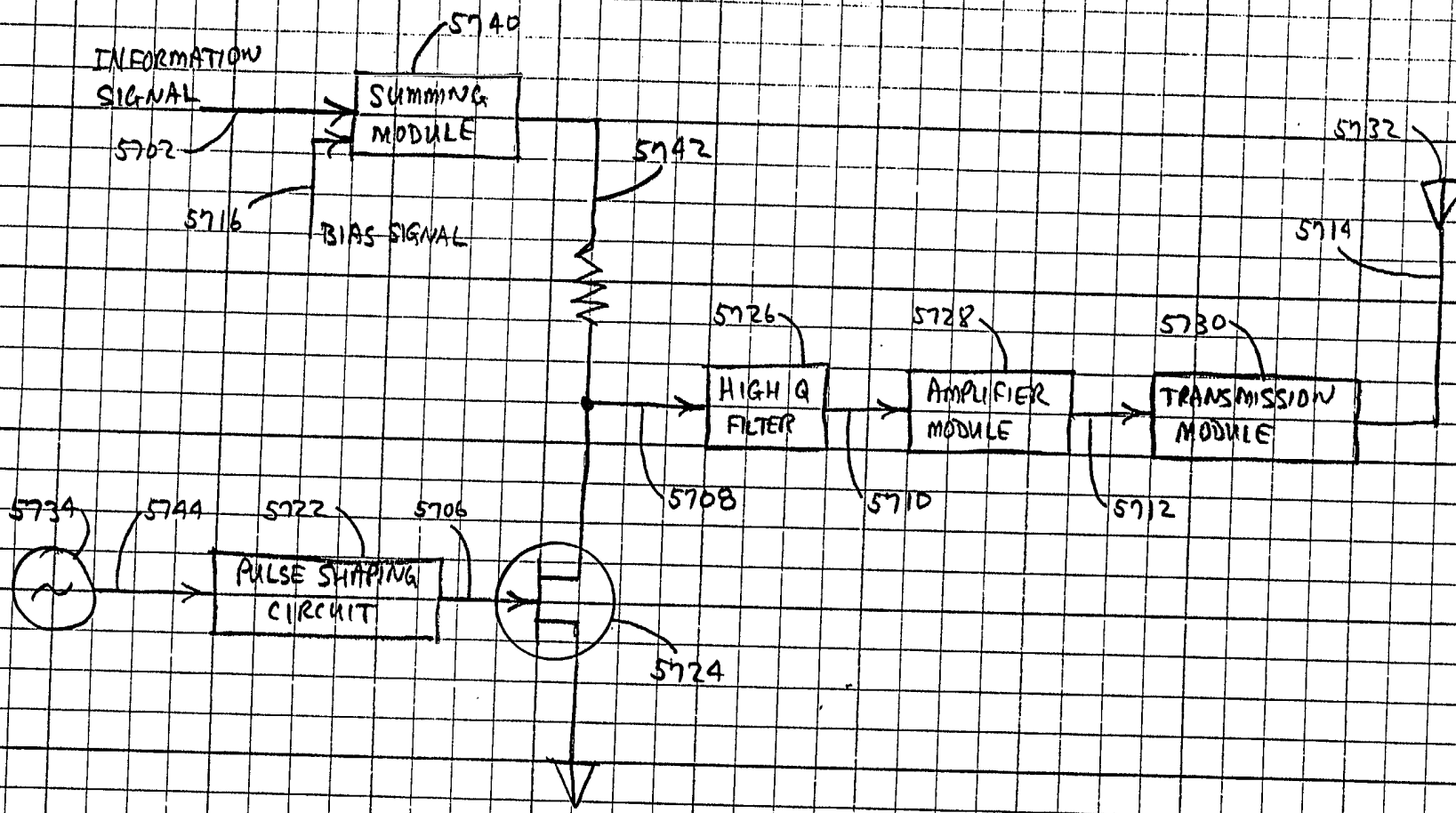
TRANSMITTER IN THE FM EMBODIMENT

FIG. 57A



TRANSMITTER IN THE PM EMBODIMENT

FIG. 57B



TRANSMITTER IN THE AM EMBODIMENT

FIG. 57C

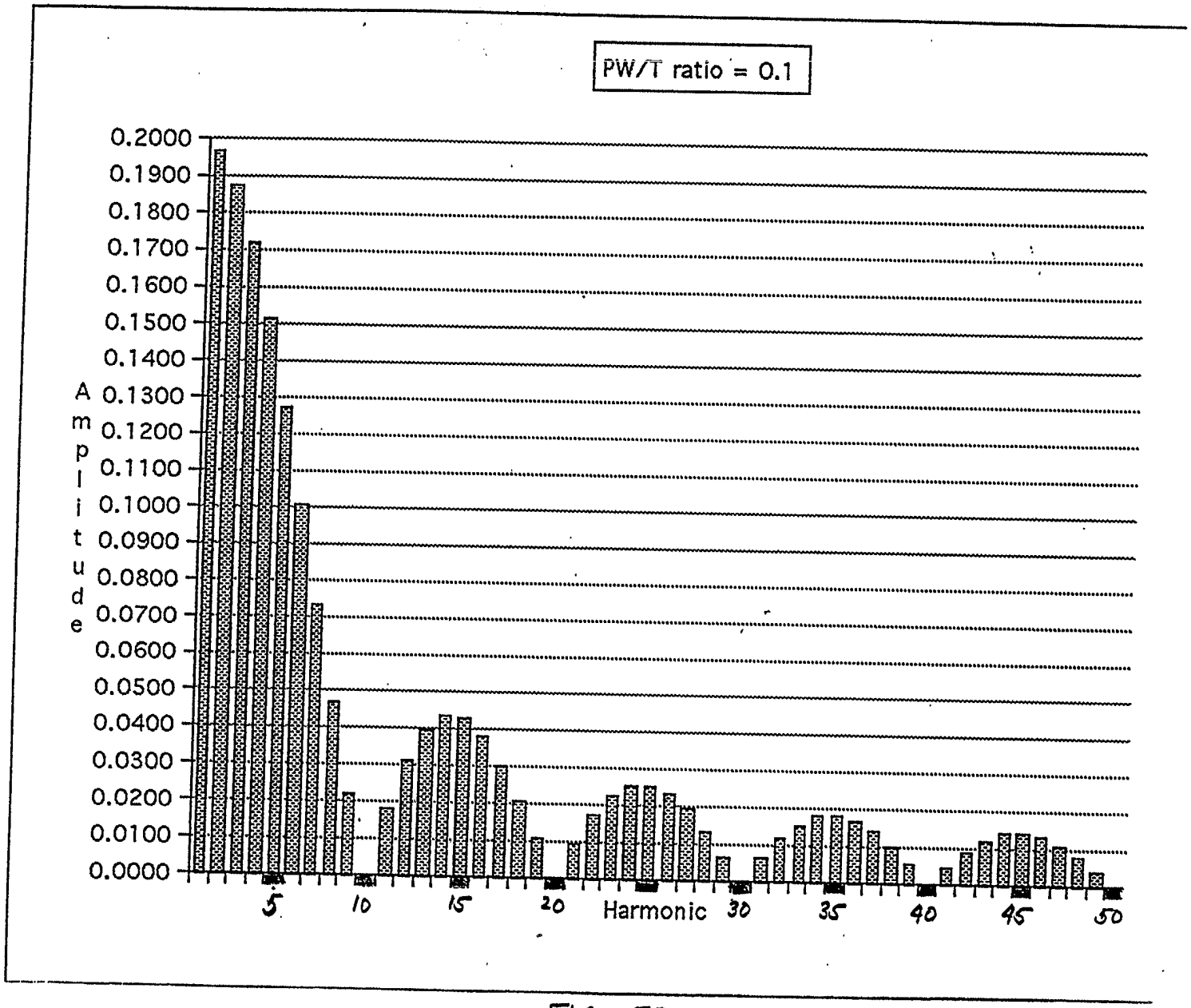

PW/T ratio = 0.1
0.2000
0.1900
0.1800
0.1700
0.1600
0.1500
0.1400
0.1300
0.1200
0.1100
0.1000
0.0900
0.0800
0.0700
0.0600
0.0500
0.0400
0.0300
0.0200
0.0100
0.0000
Amplitude
5
10
15
20
Harmonic
30
35
40
45
50

FIG. 58

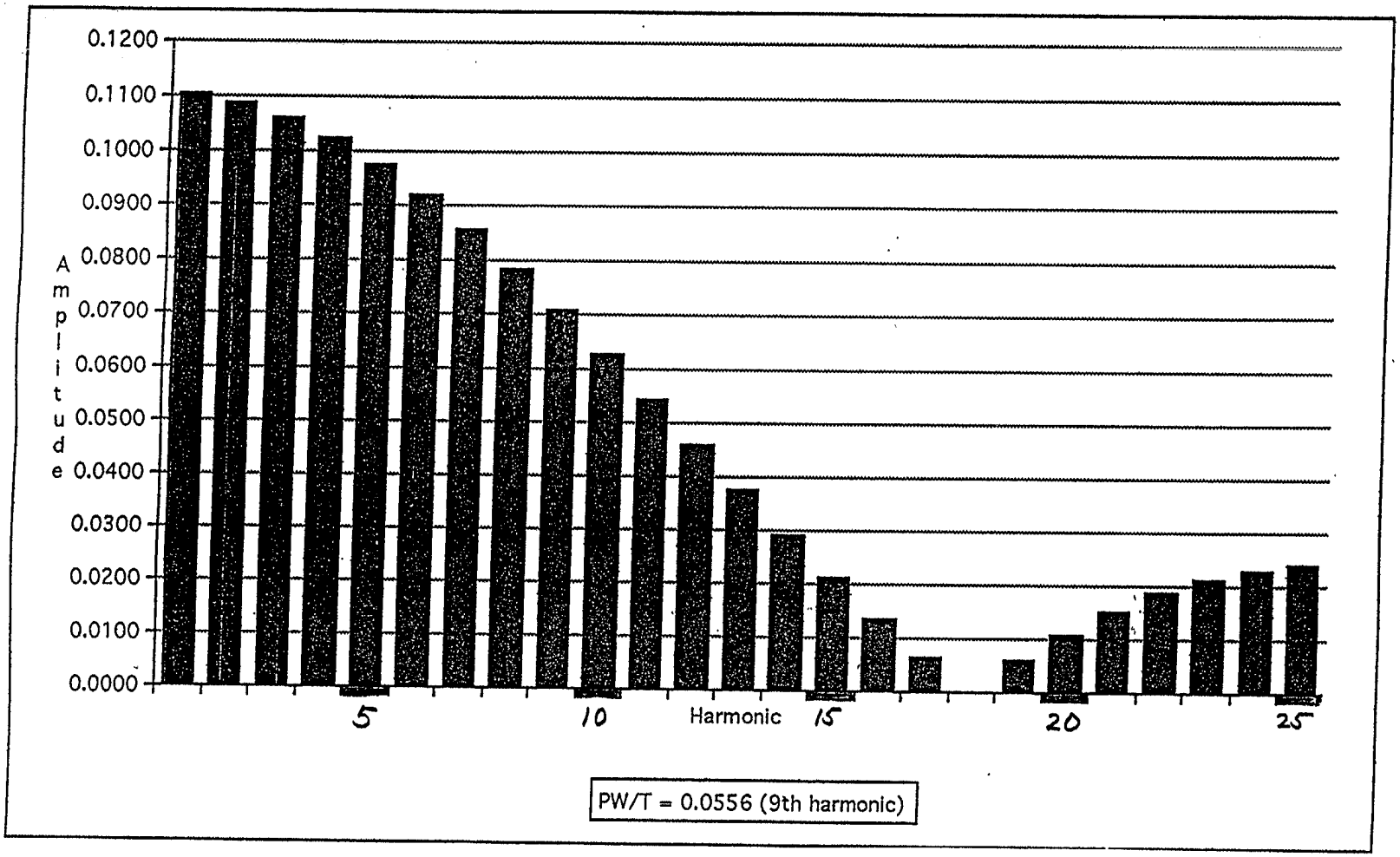

0.1200
0.1100
0.1000
0.0900
0.0800
0.0700
0.0600
0.0500
0.0400
0.0300
0.0200
0.0100
0.0000
Amplitude
5
10
Harmonic
15
20
25
PW/T = 0.0556 (9th harmonic)

FIG. 59

Harmonic	τ/T =	0.500	0.250	0.100	0.050	0.010	0.005
1		0.6366	0.4502	0.1967	0.0996	0.0200	0.01000
2		0.00	0.3183	0.1871	0.0984	0.0200	0.01000
3		0.2122	0.1501	0.1717	0.0963	0.0200	0.01000
4		0.00	0.00	0.1514	0.0935	0.0199	0.00999
5		0.1273	0.0900	0.1273	0.0900	0.0199	0.00999
6		0.00	0.1061	0.1009	0.0858	0.0199	0.00999
7		0.0909	0.0643	0.0736	0.0810	0.0198	0.00998
8		0.00	0.00	0.0468	0.0757	0.0198	0.00997
9		0.0707	0.0500	0.0219	0.0699	0.0197	0.00997
10		0.00	0.0637	0.00	0.0637	0.0197	0.00996
11		0.0579	0.0409	0.0179	0.0572	0.0196	0.00995
12		0.00	0.00	0.0312	0.0505	0.0195	0.00994
13		0.0490	0.0346	0.0396	0.0436	0.0194	0.00993
14		0.00	0.0455	0.0432	0.0368	0.0194	0.00992
15		0.0424	0.0300	0.0424	0.0300	0.0193	0.00991
16		0.00	0.00	0.0378	0.0234	0.0192	0.00990
17		0.0374	0.0265	0.0303	0.0170	0.0191	0.00988
18		0.00	0.0354	0.0208	0.0109	0.0190	0.00987
19		0.0335	0.0237	0.0104	0.0052	0.0188	0.00985
20		0.00	0.00	0.00	0.00	0.0187	0.00984
21		0.0303	0.0214	0.0094	0.0047	0.0186	0.00982
22		0.00	0.0289	0.0170	0.0089	0.0184	0.00980
23		0.0277	0.0196	0.0224	0.0126	0.0183	0.00978
24		0.00	0.00	0.0252	0.0156	0.0182	0.00976
25		0.0255	0.0180	0.0255	0.0180	0.0180	0.00974
26		0.00	0.0245	0.0233	0.0198	0.0178	0.00972
27		0.0236	0.0167	0.0191	0.0210	0.0177	0.00970
28		0.00	0.00	0.0134	0.0216	0.0175	0.00968
29		0.0220	0.0155	0.0068	0.0217	0.0173	0.00966
30		0.00	0.0212	0.00	0.0212	0.0172	0.00963
31		0.0205	0.0145	0.0063	0.0203	0.0170	0.00961
32		0.00	0.00	0.0117	0.0189	0.0168	0.00958
33		0.0193	0.0136	0.0156	0.0172	0.0166	0.00956
34		0.00	0.0187	0.0178	0.0151	0.0164	0.00953
35		0.0182	0.0129	0.0182	0.0129	0.0162	0.00950
36		0.00	0.00	0.0168	0.0104	0.0160	0.00948
37		0.0172	0.0122	0.0139	0.0078	0.0158	0.00945
38		0.00	0.0168	0.0098	0.0052	0.0156	0.00942
39		0.0163	0.0115	0.0050	0.0026	0.0154	0.00939
40		0.00	0.00	0.00	0.00	0.0151	0.00935
41		0.0155	0.0110	0.0048	0.0024	0.0149	0.00932
42		0.00	0.0152	0.0089	0.0047	0.0147	0.00929
43		0.0148	0.0105	0.0120	0.0067	0.0144	0.00926
44		0.00	0.00	0.0138	0.0085	0.0142	0.00922
45		0.0141	0.0100	0.0141	0.0100	0.0140	0.00919
46		0.00	0.0138	0.0132	0.0112	0.0137	0.00915
47		0.0135	0.0096	0.0110	0.0121	0.0135	0.00912
48		0.00	0.00	0.0078	0.0126	0.0132	0.00908
49		0.0130	0.0092	0.0040	0.0128	0.0130	0.00904
50		0.00	0.0127	0.00	0.0127	0.0127	0.00900

6000

FIG. 60

6100

Harmonic	τ/T =	0.5000 1	0.2500 2	0.1667 3	0.1250 4	0.1000 5	0.0833 6	0.0714 7	0.0625 8	0.0556 9	0.0500 10
1		**0.6366**	0.4502	0.3183	0.2436	0.1967	0.1648	0.1417	0.1242	0.1105	0.0996
2		0.0000	**0.3183**	0.2757	0.2251	0.1871	0.1592	0.1381	0.1218	0.1089	0.0984
3		0.2122	0.1501	**0.2122**	0.1961	0.1717	0.1501	0.1323	0.1179	0.1061	0.0963
4		0.0000	0.0000	0.1378	**0.1592**	0.1514	0.1378	0.1244	0.1125	0.1023	0.0935
5		0.1273	0.0900	0.0637	0.1176	**0.1273**	0.1230	0.1147	0.1059	0.0975	0.0900
6		0.0000	0.1061	0.0000	0.0750	0.1009	**0.1061**	0.1034	0.0980	0.0919	0.0858
7		0.0909	0.0643	0.0455	0.0348	0.0736	0.0878	**0.0909**	0.0892	0.0855	0.0810
8		0.0000	0.0000	0.0689	0.0000	0.0468	0.0689	0.0776	**0.0796**	0.0784	0.0757
9		0.0707	0.0500	0.0707	0.0271	0.0219	0.0500	0.0637	0.0694	**0.0707**	0.0699
10		0.0000	0.0637	0.0551	0.0450	0.0000	0.0318	0.0498	0.0588	0.0627	**0.0637**
11		0.0579	0.0409	0.0289	0.0535	0.0179	0.0150	0.0361	0.0481	0.0544	0.0572
12		0.0000	0.0000	0.0000	0.0531	0.0312	0.0000	0.0230	0.0375	0.0459	0.0505
13		0.0490	0.0346	0.0245	0.0452	0.0396	0.0127	0.0109	0.0272	0.0375	0.0436
14		0.0000	0.0455	0.0394	0.0322	0.0432	0.0227	0.0000	0.0174	0.0292	0.0368
15		0.0424	0.0300	0.0424	0.0162	0.0424	0.0300	0.0094	0.0083	0.0212	0.0300
16		0.0000	0.0000	0.0345	0.0000	0.0378	0.0345	0.0173	0.0000	0.0136	0.0234
17		0.0374	0.0265	0.0187	0.0143	0.0303	0.0362	0.0233	0.0073	0.0065	0.0170
18		0.0000	0.0354	0.0000	0.0250	0.0208	0.0354	0.0277	0.0135	0.0000	0.0109
19		0.0335	0.0237	0.0168	0.0310	0.0104	0.0324	0.0302	0.0186	0.0058	0.0052
20		0.0000	0.0000	0.0276	0.0318	0.0000	0.0276	0.0310	0.0225	0.0109	0.0000
21		0.0303	0.0214	0.0303	0.0280	0.0094	0.0214	0.0303	0.0252	0.0152	0.0047
22		0.0000	0.0289	0.0251	0.0205	0.0170	0.0145	0.0282	0.0267	0.0186	0.0089
23		0.0277	0.0196	0.0138	0.0106	0.0224	0.0072	0.0249	0.0271	0.0212	0.0126
24		0.0000	0.0000	0.0000	0.0000	0.0252	0.0000	0.0207	0.0265	0.0230	0.0156
25		0.0255	0.0180	0.0127	0.0097	0.0255	0.0066	0.0159	0.0250	0.0239	0.0180

FIG. 61

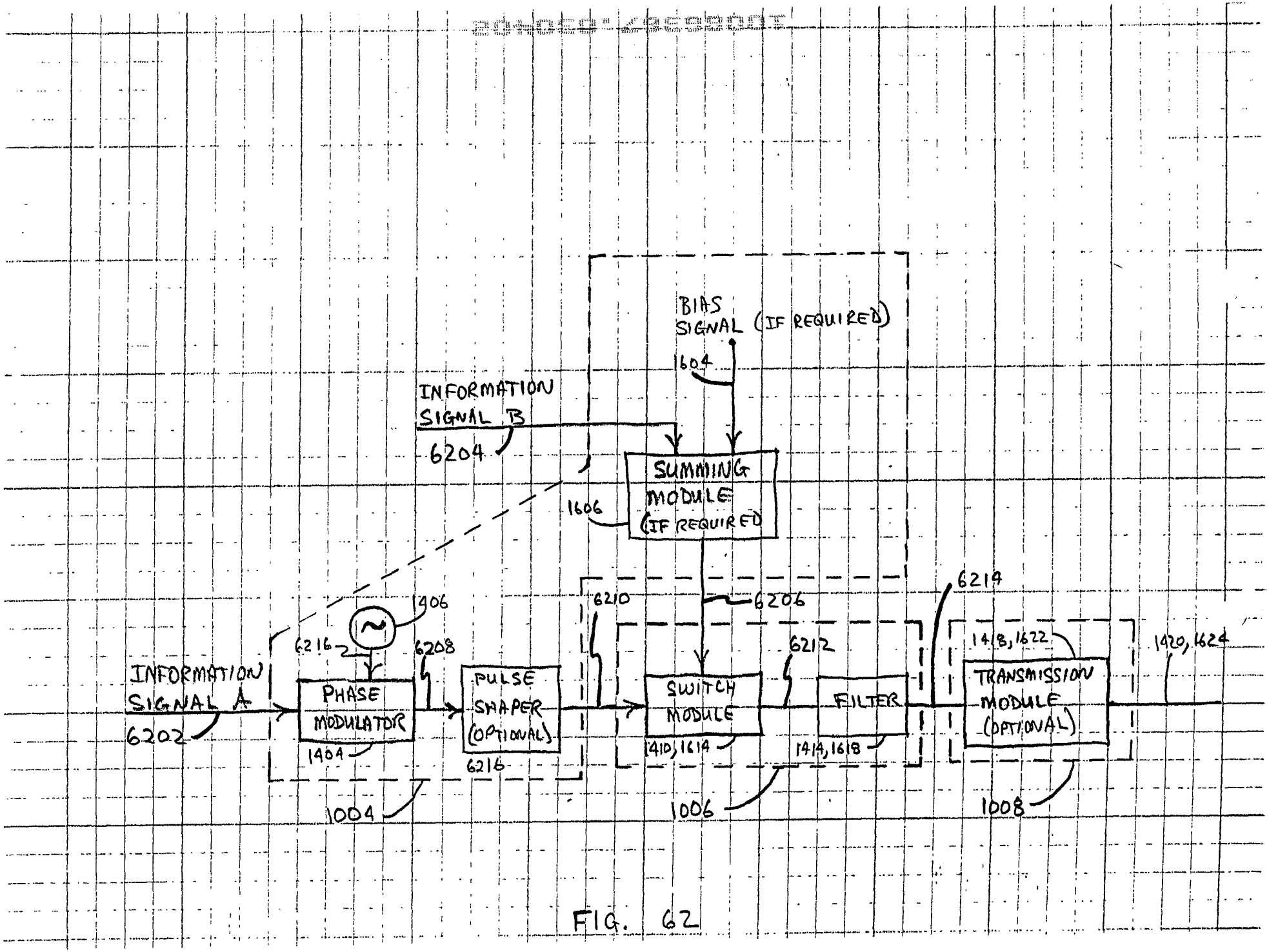

BIAS SIGNAL (IF REQUIRED)
1604
INFORMATION SIGNAL B
6204
SUMMING MODULE (IF REQUIRED)
1606
6214
6210
6206
1406
6216
6208
6212
1418, 1622
1420, 1624
INFORMATION SIGNAL A
6202
PHASE MODULATOR
1404
PULSE SHAPER (OPTIONAL)
6218
SWITCH MODULE
1410, 1614
FILTER
1414, 1618
TRANSMISSION MODULE (OPTIONAL)
1004
1006
1008

FIG. 62

INFORMATION SIGNAL A 6204

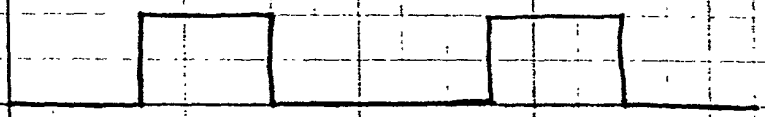


FIG. 63A

OSCILLATING SIGNAL 6216

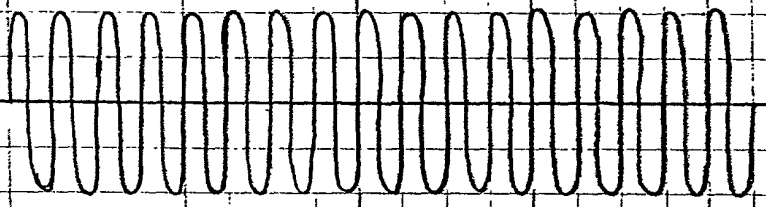


FIG. 63B

PHASE MODULATED SIGNAL 6208

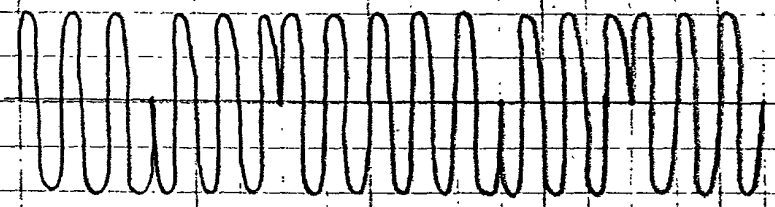


FIG. 63C

PULSE-SHAPED PM SIGNAL 6210

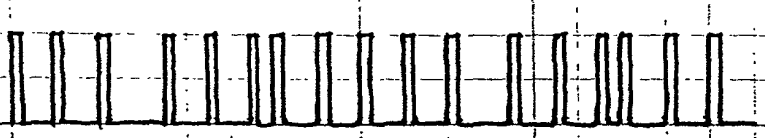


FIG. 63D

FIG. 63

+V

REFERENCE SIGNAL 6206

0

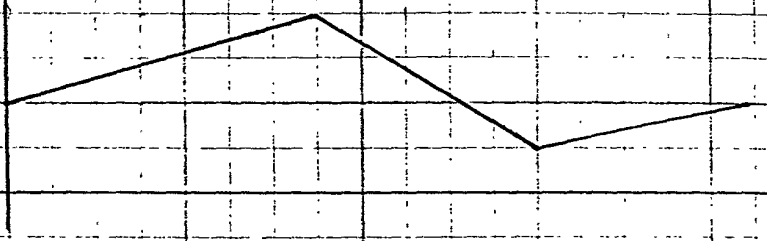


FIG. 63 E

HARMONICALLY RICH SIGNAL 6212

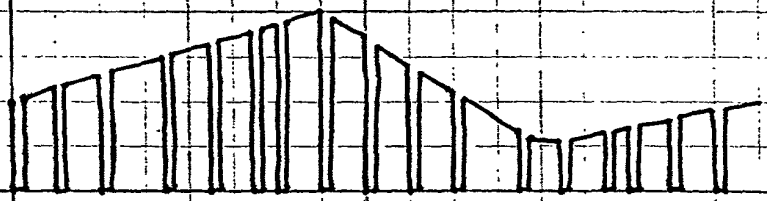


FIG. 63 F

FUNDAMENTAL HARMONIC OF SIGNAL 6212

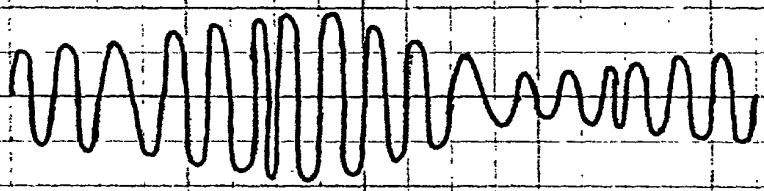


FIG. 63 G

SECOND HARMONIC OF SIGNAL 6212

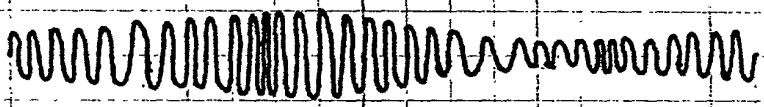


FIG. 63 H

FIG. 63 (continued)

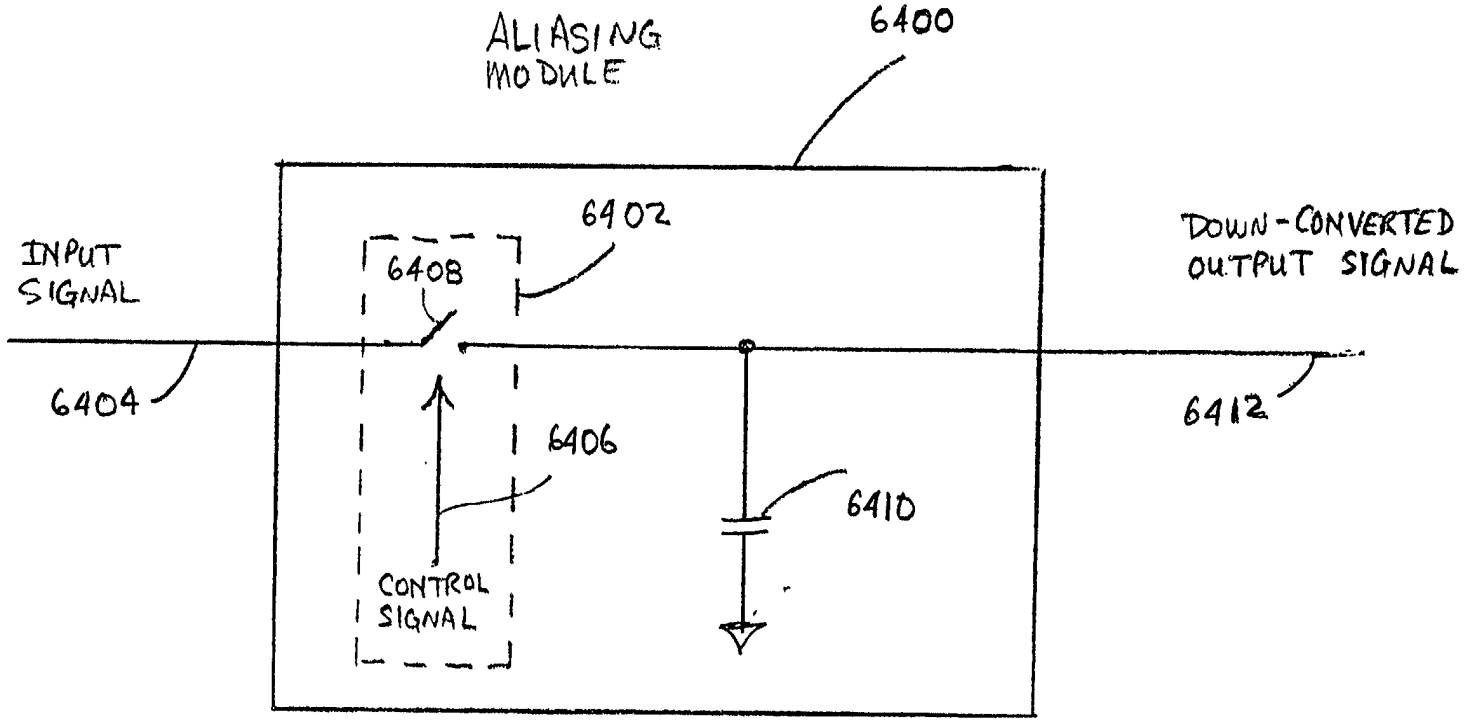

ALIASING MODULE
6400
6402
6408
INPUT SIGNAL
DOWN-CONVERTED OUTPUT SIGNAL
6404
6406
6410
6412
CONTROL SIGNAL

FIG. 64A

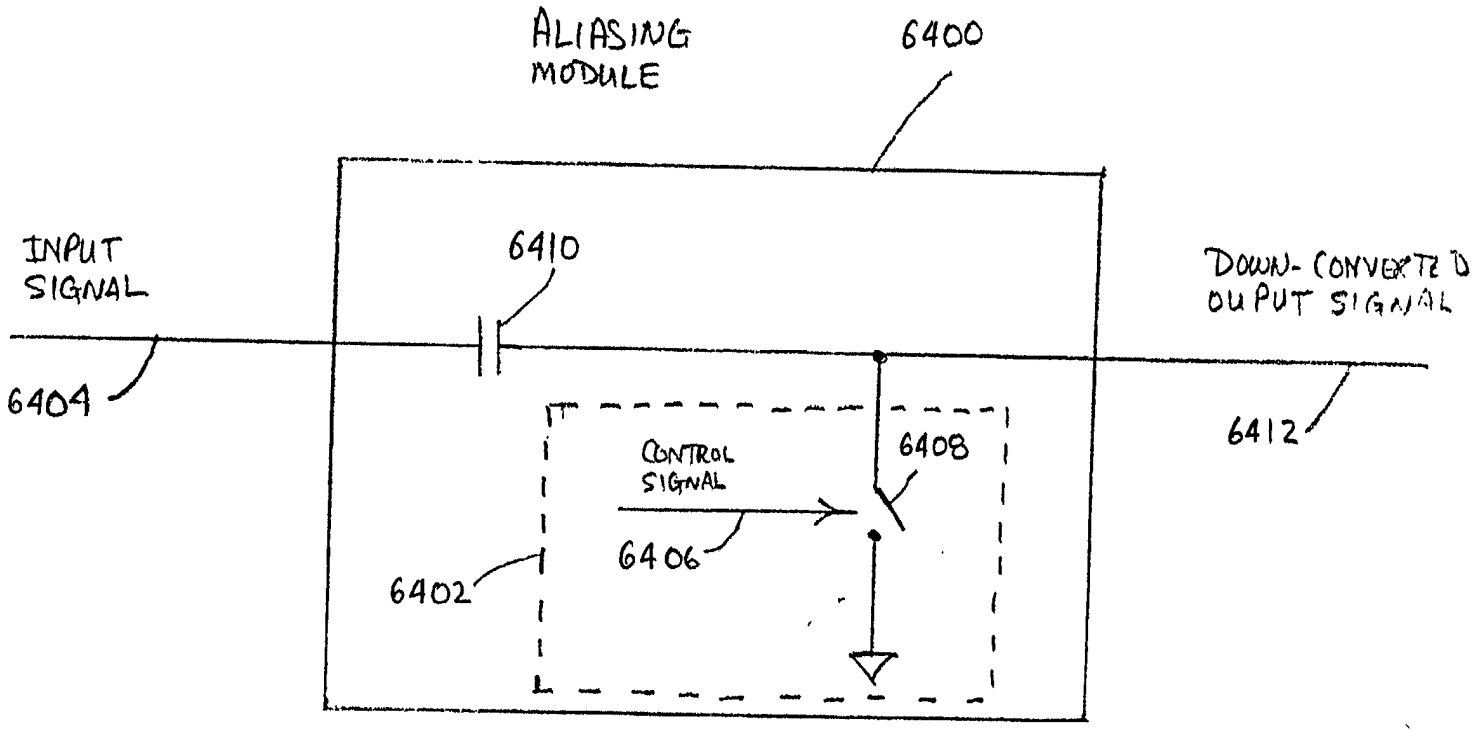


FIG. 64A-1

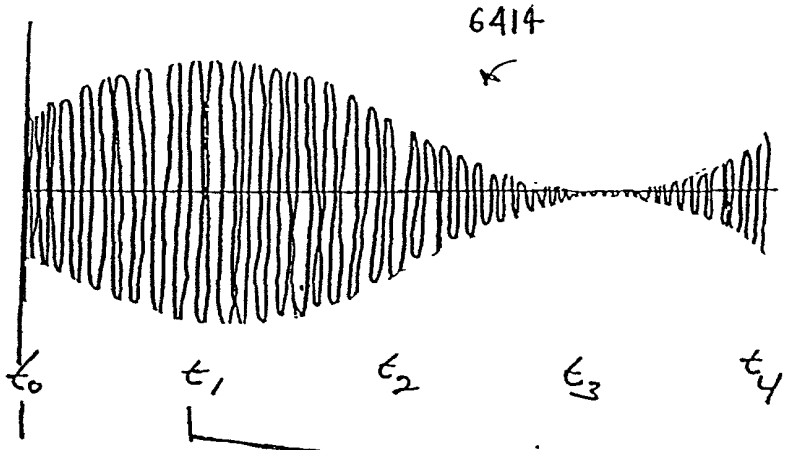


FIG. 64B

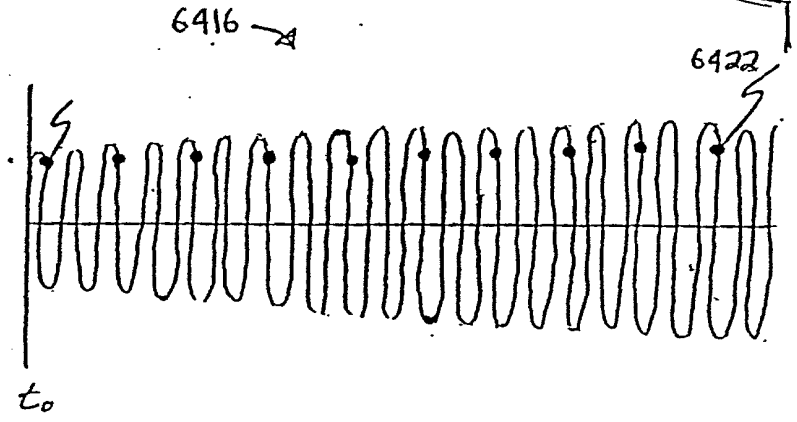


FIG. 64C

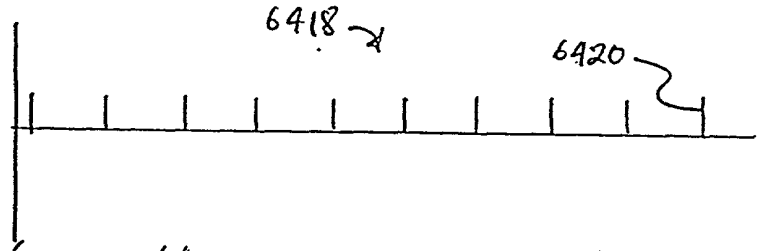


FIG. 64D

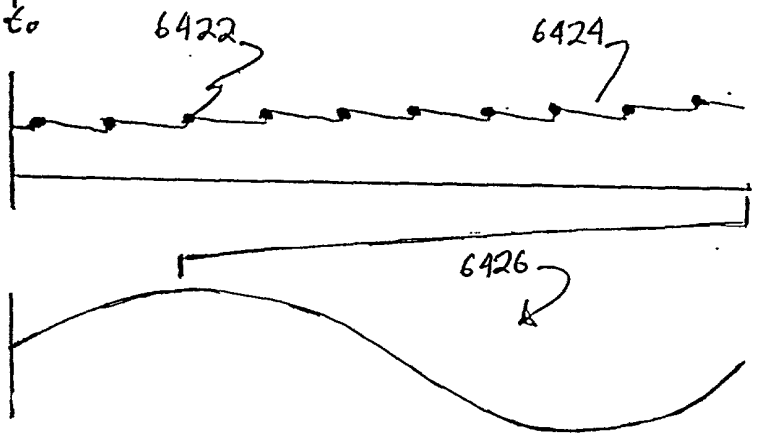


FIG. 64E

FIG. 64F

FIG. 64 (continued)